AMERICAN DYESTUFF REPORTER

"Circulated Everywhere Dyestuffs Are Used"

Published by Howes Publishing Company, 440 Fourth Avenue, New York

Devoted to the practical application of dyestuffs in all industries; especially to textile chemistry—the science and practice of scouring, bleaching, dyeing and finishing.

Volume XIX | NEW YORK, MARCH 17, 1930 | Number 5

Jute Fiber and its Processing, Dyeing and Bleaching

Raw Jute Fibre, Its Cultivation and Preparation for Commerce—Manufacturing Processes—Batching and Softening—Card Room Procedure—Spinning—Salable Forms of Jute—Dyeing General Consideration—Stock Dyeing—Checking Up—Yarn Dyeing—Piece Dyeing—Bleaching

By FRANCIS C. HOLDEN

JUTE is a bast fiber consisting of cellulose and lignin, not necessarily a mixture but believed to be united in a homogeneous complex. Experiments with jute and tanned cotton result in such similar reactions that it is often stated that jute contains tannin substances. It is, however, impossible to isolate tannin as such from jute fiber.

The jute plant grows particularly well in a warm, humid climate reaching a height of from six to twelve feet and varying in color from grayish tan to a light brown. Practically all of the jute of commerce is grown in the Bengal district of India where the climatic and soil conditions are favorable and the help situation is such as to enable the farmers to produce a tremendous amount of marketable fiber at a minimum cost.

The actual jute fiber which is ultimately used for the manufacture of yarn, twine, rope, etc., surrounds the stalk of the plant as bark covers the trunk of a tree and is in turn covered with a thin bark or cuticle. To remove the fiber it is necessary to soften the cuticle which is accomplished by the process known as retting. This consists of soaking (Fig. 2) the stalks in water for two or three weeks whereby fermentation sets in disintegrating the structural part of the plant. The fiber is then readily stripped (Fig. 3 and 4) from the so-called jute stick and is dried in the sun. (Fig. 5) The stick is used for building huts and fences and for firewood.

After drying, the jute is tied up in bundles and delivered to the baler or if for local mills delivered directly. (Fig. 6) It is interesting to note that the actual amount of dry fiber represents only five per cent of the actual weight of the green plant. One can hardly imagine the tremendous amount of labor involved in growing, cutting, retting and hauling the enormous amount of jute vegetation necessary to annually produce the required amount of jute fiber, especially under the primitive conditions of plowing (Fig. 1), cutting and hauling that exist in India to-day.

The amount of jute fiber produced in India annually approximates ten million bales of four hundred pounds each. Of this vast quantity, forty-five per cent is shipped to other countries, while the remaining fifty-five per cent is processed in the mills, in and about Calcutta. In India jute is principally manufactured into bags and burlap and some cordage and rope. A noteworthy fact is that practically all of this great quantity of jute is raised by small independent farmers, free from capitalistic control and numbering with their helpers in the neighborhood of three million people.

The grading or sorting of jute into marks is accomplished by both the farmer and the baler. A mark is simply a name or symbol disignating a known quality of jute and may be depended upon to insure the buyer of a reasonably accurate purchase. For export purposes the jute is packed in very hard compact bales of four hundred pounds which are securely tied with about six pounds of rope and carefully marked with a small burlap label, tied in with the rope. The mark, symbol or name of the quality of the jute is stamped on the burlap.

Large cargoes are shipped to this country in steamers which carry from thirty to fifty thousand bales. Many fires have occurred in jute cargoes, either en route or in dock, necessitating the thorough soaking of the contents of the compartment, wherein the fire is discovered. The resulting swelling of the bales is interesting due to the great pressure exerted against the steel walls and steel girders of the steamer. Such pressure is sufficient to bend steel girders out of place and to tear heavy sheet steel away from its rivets. Accordingly it is advisable to store jute bales in warehouses in such a manner as to allow for considerable expansion in the event of a sprinkler head letting go or water being applied for some other reason.

Manufacturing Processes

The several mill operations through which jute fiber must pass are outlined as follows:

Opening
Batching
Softening—Conditioning
Carding—Breaker Card Finisher
Drawing—First—Second—Third
Roving
Spinning—Singe end—Double end
Twisting
Winding.

The opener is a heavily constructed machine consisting of two strong fluted rolls weighted with powerful springs allowing for an uneven opening. The rope is removed and sections of the bale of jute fiber are passed through these rolls thereby softening them and enabling the operative to more easily separate the individual heads of jute. All bales are not so tightly held together as to require this treatment.

Batching and Softening

Batching is a sorting operation in which the operative, known as a batcher, separates the better grade of stock from the poorer grade and at the same time divides the large heads of jute into workable sizes known as stricks. These stricks are given a slight twist to hold them intact and are placed on a truck in such a way as to facilitate the work of the operative who next handles them.

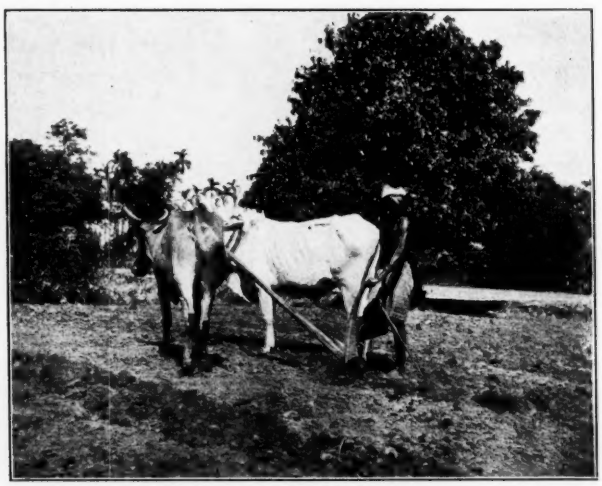

Figure 1. Ploughing Jute Field

Softening is a very important process in the making of jute products and requires constant care and precision to insure a uniformly softened and oiled fiber. The jute softener (Fig. 7) consists essentially of a feeder apron, about 50 pairs of steel rolls generally fluted, a delivery apron and apparatus for the application of emulsion. The stricks of jute are placed on the feeder apron one at a time, carried to the rolls through which they pass under pressure which is applied by springs. As the jute passes through the rolls it receives automatically a sprinkle of oil emulsion which is applied in such a way as to insure a reasonably accurate and uniform distribution. The operative at the take-off end of the softener picks up each strick singly, gives it a slight twist by a wrist movement and places it on a truck in carefully weighted amounts. These weighed quantities of oiled stricks are known as dollops and are so weighed as to enable the operative on the breaker-card to more accurately feed the machine.

To insure a more thorough distribution of oil emulsion the truck loads of jute from the softener are kept intact for a period of at least twelve hours, preferably in a humid atmosphere. This procedure is known as conditioning.

The object of the emulsion application is to provide a suitable lubricant for the fibers, soften the hard compact sections of the strick and provide a dust retarding agent. An insufficient amount of emulsion results in a weak uneven yarn and dustry card rooms. Too much emulsion or oil applied at the softener results in lapping on the carding and drawing machines, thereby developing large quantities of waste. Uneven application of emulsion results in slubs or lumpy yarn, uneven yarn which means heavy and light yarn for the same count, and a generally poor quality product. Practically, then, a proper softening operation is the very foundation upon which rests the success of subsequent operations.

It is a common practice, at least in the United States, to use emulsified paraffine oil 28° Beaumé for jute fiber lubrication. Numerous methods have been devised whereby soft-soap, alkali, wool-grease, reclaimed leather oils, sulphonated oils, rosin and red oil mixtures, fish and whale oils, mineral oil derivatives, mineral soaps, etc., are utilized in various ways to produce the required emulsion. A reasonably stable emulsion is desired and it is usually made to carry twenty-five to thirty-five per cent of oil. Sufficient emulsion is added to the fiber to increase its weight fifteen to twenty per cent. The amounts of emulsion used is dependent on weather conditions and the jute stock. The former consideration has been largely overcome by humidifying systems. The finished product, therefore, carries from under four per cent to as high as seven per cent of oil.

Certain jute products have specified requirements which necessitate special emulsions for their processing. Stainless twine for instance must be made so that heavy and prolonged pressure will not bring out the least trace of oil on unglazed paper. Kerosene emulsions or mixtures are applied to certain types of jute yarn which are used in the manufacture of fuses.

It is good business to maintain a routine control over the emulsions, samples being taken from the working supply at least once a day. Steam coils often develop leaks allowing the condensed steam to enter and dilute the emulsion; water valves may be inadvertently opened, and it is quite possible for emulsions to become mixed. Oil content being the principal consideration, it may be readily checked by being thrown out with acid in a tall narrow graduated cylinder. Emulsions of the type that do not

throw out clearly with acid are checked by the Xylol method.

In the manufacture of the lower grades of twine large quantities of cuttings or butts are used. This material which is cut from the base of the jute stalk is from six to twelve inches in length, contains a large percentage of bark and woody fiber and is darker in color than the long jute.

Card Room Procedure

Card room procedure consists first of passing the jute through a breaker-card wherein the action of pins set in rollers which are properly adjusted as to speed and position, tend to tear the fibers or rather split them while at the same time mechanical impurities, short fibers or bark, are combed out. The fibers from the breaker-card are delivered in the form of a coarse sliver, as many as ten ends of which are fed into the finisher-card at once.

The finisher-card performs a similar operation to that of the breaker-card, although of a somewhat finer and more exacting degree of separation. The jute is delivered from the finisher-card in the form of a single clean sliver which is packed in silver boxes or cans.

From the finisher-card the sliver is put through a drawing, doubling and drafting operation to parallelize, draw out and give uniformity to the sliver. The machine for giving these collective operations is called a drawing machine. In this machine as many as two to four ends of card sliver are drawn through pins thereby being put into a parallel position, then drawn out or drafted and delivered as a single end.

Second drawing is a repetition of first drawing although the pins are somewhat finer and more closely set than those of the first-drawing machine. An additional or third drawing is sometimes required for the production of very fine and high-grade yarns.

In the next or roving operation the single ends of sliver from the previous operation are again drawn through pins and delivered to a spindle and a flyer which impart a twist to the fibers. The twisted fiber known as roving is simultaneously wound on large roving bobbins. The size or weight of the roving is controlled by a system of gears which apply directly to the draft or drawing of the fibers while still other gears apply to the twist of the fibers. In the form of roving jute is often sold either single or plied, as various types of twine or rope, or for special commercial purposes, treated or untreated.

Spinning

In the spinning operation the jute rove is drawn out or drafted to size required between drawing and retaining rollers, conducted to a rapidly revolving spindle and flyer which twist the fibers into yarn and at the same time wind the finished yarn on spinning bobbins. A spinning frame consists of as many as 100 spindles, each spindle producing a single end of yarn simultaneously. When the spinning bobbins are full the machine is stopped, the full bobbins removed and replaced by empty bobbins, an operation called doffing and requiring considerable help in the spinning room to obtain maximum production. Within fairly recent years, automatic doffing mechanism has received favorable consideration.

Double spinning consists of passing two ends of roving into a single draft to produce a single end of finished yarn. Certain advantages of increased strength and uniformity are thereby obtained.

Salable Forms of Jute

Finally the yarn is put into salable form, that is, it is wound in the form of large tubes for warp yarn, cones and cops for filling yarn, skeins, if it is to be skein-dyed, and numerous special put-ups depending on the requirements of the consumer.

Figure 2. First Steeping of Jute

Yarn for the twine trade is twisted into the desired number of plies by one of several methods and is sold finished or unfinished in the form of balls, tubes, reels or coils. By finished twine is meant starched and polished twines, the starch mixture consisting of corn and tapioca starches with gums, oils and waxes added to produce the desired finish and pliability. Besides fabrics, other treated jute products such as tarred and oiled rove and yarn, waxed rove, asphalt treated rove and yarn, and dyed material are in considerable demand in commerce.

Dyeing General Consideration

It is not necessary, as is often stated, to scour or boil out jute as it is with wool or cotton. In fact the action of alkaline liquors on jute develops a reddish brown coloration which is very detrimental to the production of many colors. Previous to bleaching it is advisable to wash the yarn in warm water, but in the usual dyeing practice it is customary to enter the yarn directly into the dyebath without any previous treatment.

Jute is dyed very easily, types of practically all classifications of dyestuffs being readily applied without the necessity of mordanting the fibers. The dyer, then, is confronted with the problem as to which type of dyestuff to use to obtain the greatest all-around advantage. Basic and acid dyes are applied directly with the addition of Glauber's salt and alum or acetic acid either in a warm or boiling bath. Direct dyes are applied directly with the addition of Glauber's salt but in general require a boiling bath for best results. Sulphur and vat dyes react with jute as they do with cotton and are merely mentioned

because of that fact since the increased fastness to washing obtained with sulphur and vat dyes is of very questionable value when applied to jute products. A consideration of light fastness develops the fact that certain chosen dyes of the direct class withstand the action of sunlight fully as well as do vat dyes when dyed on jute. Moreover, the cost of dyeing sulphur and vat dyes would prohibit them since the economic question is decidedly prominent in jute processing. The vegetable dyes, logwood, cutch, etc., have been used to considerable advantage on jute, but in the present market, direct and acid dyes are distinctly preferable. Single bath logwood black on jute has a decided tendency to crock which makes it inferior. Cutch is used extensively for treating rove, the object being to provide a suitable counteractive to the growth of fungus material. In this case the cutch is applied without the addition of metallic salts, the usual procedure in dyeing cutch brown, but rather is held in the fiber by the aid of a thin boiling gum.

Figure 3.
Children stripping jute fibre from stalks after retting of plants. (The plants were the weedings, i. e., stalks showing slower growth, also plants cut down to provide paths through the field. As compensation for this work, the children are receiving the pith or stick of the plant from which the fibre is stripped. These sticks are used in the building of huts, fences, etc., and for firewood). The pith or stock is seen lying on the ground, also standing bundled at the left.

Returning to the first three named dyestuffs it is readily shown that the basic group possesses the greatest tinctorial power with the acid group a weak second and the direct group not far behind, money value considered. However, the basic group is extremely fugitive to light and besides has such a strong affinity for jute fibers that the tendency is to dye unevenly and for continuous machine work is particularly difficult to control. Even so the basics are very desirable and may be used to great advantage for brightening colors either as a top color or in conjunction with acid or direct dyes. It is preferable to make the combination at the commencement of the dyeing and thus save the labor involved in giving a second dip. Combining basic with acid or direct dyes may sometimes prove disastrous unless properly handled, that is, the respective types of dyes should be dissolved separately and added to the dyebath separately. Of the basic group Methylene Blue, Methyl Violet, Malachite Green Crystals, Auramine and Saframine constitute a list that could be used to brighten most any dyeing, very small amounts being required.

The choice between acid and direct dyes for jute depends largely on the requirements and method of application involved. Insomuch as acid dyes possess higher tinctorial power and may be dyed in a bath at 140° F., it is reasonable to expect that they may be applied more economically. The matter of the temperature of dyebath means a great deal more than the mere saving of steam since, when dyeing at 140° F., the batch is completed in less than ten minutes and the yarn is at all times easily handled. This makes for very high production especially in open tub hand work. Two good men with a desire to work, being on a piece basis, can stick up, dye, strip and place on a truck or rather numerous trucks thirty to forty batches of one hundred and ten pounds daily. These short time dyeings are productive of genuine good work, fulfilling all requirements of fastness, are brighter than boiled colors but in all cases are not thoroughly penetrated. In order to obtain thorough penetration it is generally necessary to boil the yarn. Numerous so-called penetrating assistants have been tried out on jute but as yet none has showed any advantage. On the other hand certain dyestuffs give very good penetration at 140° F.

Thorough penetration is one of the requirements of carpet yarn for cut work called jute velvets, and for this material either acid or direct dyes may be used to advantage, the time of dyeing being one-half hour. It may seem somewhat paradoxical to develop a dyeing at 140° F., in less than ten minutes and yet require thirty minutes at a boil. However, while the dyeing at 140° F. is uniform, if entered into a boiling bath it would not be level in so short a time. Moreover, the additional time is taken to insure penetration. In the acid group Nathol Black or Acid Blue-Black, Metanil Yellow, Orange A, and Croscein Scarlet form a nucleus with which most any conceivable color may be produced in conjunction with the previously mentioned basic group. Standard products of the four acid dyes named are very powerful tinctorially, dye uniformly, possess reasonable characteristics of fastness on jute and are sold under strict competition, thereby giving good money value. They also work together very well and would comprise the bulk of the dyestuffs used being particularly well adopted for jute yarn dyeing.

It is essential that yarn for the knit goods trade known as crochet yarn not only be thoroughly penetrated but possess especial fastness to rubbing as well. When any particular requirements of fastness are specified it is found that some of the direct colors give the best results. In this group we meet special conditions that do not permit of such generalization as possible with the other groups. It is sufficient to state that direct colors with reputed characteristics of fastness on cotton should in most cases give similar results on jute. Direct colors are more easily controlled in the continuous piece dyeing

operation and excel for making colored starch mixtures especially when the starch mixture is of an alkaline reaction.

It is possibly apparent that a well regulated jute dyehouse should carry in stock an assortment of basic, acid and direct dyestuffs but would have little or no use for scouring or penetrating agents, softening oils or dyeing assistants.

Stock Dyeing

Jute stock is rarely dyed by being subjected to the action of hot or boiling baths and requiring the following extracting and drying operations. Such treatment has a tendency to detract from the quality of the fiber, from a carding and spinning viewpoint, resulting in a lower quality yarn. The stock is, however, colored very inexpensively by applying colored emulsions during the softening operation. By this method colors of from light to medium depth are produced which have a sort of heather yarn appearance. This is due to the fact that the colored emulsion strikes the fibers irregularly leaving considerable uncolored stock. The blend is made in the carding and drawing operations. Such yarn is particularly adaptable for carpet backs and filling. Extremely strong direct dyes carrying a minimum of salt are required for this type of work. The yarn receives a final steaming action which sets the color and provides the customer with a well-dyed product at a very low dyeing cost.

Figure 4.
Stripping retted jute from the central pith or stick. Showing the procedure in this section of Bengal of first breaking the stalks near the root ends with the bamboo or wooden mallet. This does not break or cut the fibre. The fibre is first drawn from the short broken sticks at the root end, and the drawing then continued from the long, remaining portion of the stick.

Jute stock is given a full bleach, rinsed, soured with acetic acid, again rinsed and after drying and carding is a clean sterilized jute batting suitable for hospital purposes. The acetic acid sour gives an especially soft finish.

The peroxide bleaches give very fine results on jute with a softer finish than that of the lime bleach. The time of bleaching is somewhat longer and the expense involved more than with lime so that the peroxide processes have not been generally adopted for jute.

Since the term bleaching covers a very broad field it may not be amiss to mention a few of the common methods applied in jute processing whereby the fibres are changed to a lighter or brighter appearance.

Dilute solutions of phosphoric acid are utilized to brighten jute twine, the application being made on the polisher machine before the twine enters the starch or color boxes.

Quick results in dyeing bright colors are obtained by first giving the yarn a wash in an oxalic acid bath at 140° F. thereby brightening the stock. The bath is made up with three pounds of acid per one hundred pounds of yarn, the bleaching action requiring ten minutes.

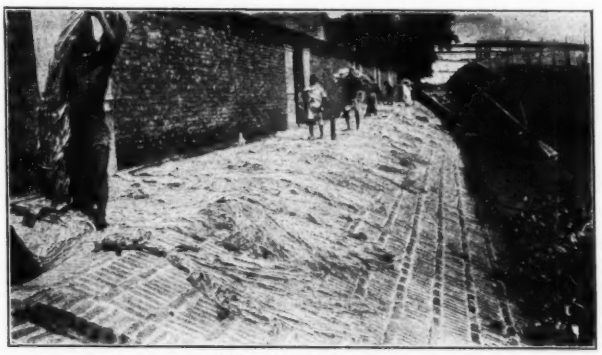

Figure 5. Drying Jute.

For some reason, possibly aesthetic, unfinished jute twine of a fairly light color is regarded with more favor than that of a similar twine but slightly darker in color. To meet the conditions jute stock is sometimes brightened or made slightly brighter by the bleaching action of sulphite products. The solution of sulphite liquor is applied on the softener in conjunction with the oiling operation.

As in the case of dyed jute piece goods, bleached jute represents but an extremely small percentage of jute goods processed.

Checking Up

It is quite necessary that jute products be closely checked both during the processing and when finished to maintain a standard quality. Moreover, jute material moves very rapidly through its several operations and if any condition were wrong large quantities of waste or inferior material would quickly gather. Tests are accordingly made at the roving frames and in the spinning room to check the weights of the rove and yarn. The finished yarns and twine are sold on a feet per pound basis of a standard breaking strength. Samples from each day's run of the various products made are tested for yardage and break. The testing should be conducted under uniform conditions and it is customary to build a room for this purpose which is kept under accurate control as to temperature and humidity. It is only by careful check-ups that jute products may be expected to be held to a standard quality.

To produce full colors such as heavy browns, greens, etc., on jute stock without detracting from the quality

of the fiber, special apparatus has been devised which is somewhat similar to the softening operation except that the whole strick of jute is colored intact. As in the previous method the yarn is finally steamed, the product also being especially adaptable in the carpet trade. It is only in lots of 10,000 pounds or more that this method is of practical value.

Yarn Dyeing

Jute yarn is dyed in skein form in both machines and open tubs; in the form of cops in special cop dyeing machinery; during the dressing or slashing operation, in special apparatus known as polishing machines; and in the form of tubes in package dyeing machines.

Figure 6.
Tossa jute in large kukha bales at the entrance to Ganges Jute Mills.

Skein dyeing has been the most common method of dyeing but in recent years has been somewhat superseded by the cop and slasher methods and to some extent by the stock dyeing method. When large quantities are required the stock dyeing method is the least expensive. Jute skein dyeing follows the customary dyehouse procedure wherein the yarn on sticks is entered the dyebath which contains the proper amount of color and five per cent of Glauber's salt with two per cent of alumn. In the case of handwork at 140° F., the yarn is given four turns and four passes and thrown out finished. Similar work at a boil is given three turns and three passes, then allowed to stand at a boil for ten minutes when it is given another turn and allowed to stand ten more minutes, at the expiration of which it is given a final turn and thrown out. Machine dyeing follows the usual procedure, time limitations excepted. It should be understood that this type of work is routine, established formula work wherein each batch of yarn is carefully weighed and each formula weighed with precision. Except in the case of an error it is rarely necessary to make additions in order to produce satisfactory color matches. Whenever possible, the dyeings are carried on in standing baths thereby saving considerable dyestuff, steam, water and time, since none of the types of dyestuff exhaust at all well on jute.

Cop dyeing is accomplished with the aid of machinery wherein the cops are placed on perforated spindles and the dye liquor forced through them until the desired color is obtained. This is a rather expensive method of dyeing but insomuch as it is generally necessary to size the cops for weaving, the dyeing and sizing may be produced in one operation.

Colored jute twines are often dyed on the polishing machines which consist essentially of color boxes, rubbing and polishing rolls, squeeze rolls, drying cans and take-up mechanism. The yarn, generally plied, is drawn through the color boxes by the squeeze rolls, receiving a rubbing action to rub off surplus color mixture. It is then conducted over drying cans and at this stage of the operation is brought in contact with rapidly revolving, polishing rolls which impart a finish to the twine. If a high polish is not desired the polishing rolls are drawn out of contact. From the drying cans the twine passes to the take-up bobbins. Direct dyes are generally used, usually in conjunction with starches, flour, waxes, gums and oils.

In carpet mill practice it is customary to size jute stuffing and backing yarns. Whenever colored backs are required, it is only necessary to add the proper amount of dye to the sizing mixture, thereby dyeing the yarn at a very little cost. Some slashers are set up with three or more color boxes to provide for the application of several colors simultaneously.

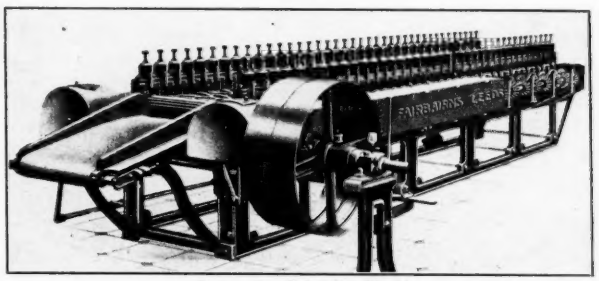

Figure 7. Softening Machine.

Package dyeing on jute is conducted in the usual way, direct dyes being preferable since they combine more slowly than the acid or basic dyes and therefore penetrate better. Jute package dyeing is not a very common practice but is a method adopted by job dyehouses for specialty work.

Piece Dyeing

Jute piece dyeing is conducted principally for the decorative trade. Burlap of various weights is dyed bright full colors on the jig or continuous machine or padder. Acid or direct dyes work very well on the jig while direct dyes are preferable for the continuous machine. The jig is adaptable for small orders while for padding, reasonably large orders are required. Jute canvas or blanket cloth is dyed in the piece and used for horse-blankets. It is surprising what thorough penetration may be obtained by giving heavy jute blanket material a single dip in a short padding bath at a boil, followed by a run through a single

pair of squeeze rolls. Jute webbing for the upholstery trade is usually sold in the natural color, often with a red or black marker or stripe. When required in colors, however, it is dyed on narrow fabric finishing machinery which essentially consists of a padding-box, squeeze rolls, drying cans and take-up apparatus for rolling the webbing. An extremely small proportion of jute woven goods is dyed, most of it being used for bagging and baling purposes, where color is quite unessential.

Bleaching

Bleached jute finds very little application in commerce. When required, however, it may be bleached by several methods the result being a light and brilliant cream as compared with bleached cotton or linen. Numerous laboratory samples have been brought forward as samples of pure white jute, but the demands of business have never justified the commercial developments of such processes.

The common method of bleaching jute, generally in yarn form, involves the use of bleaching powder, that is, chloride of lime carrying approximately thirty-five per cent available chlorine. Hand tubs or machines may be used, the former being favorably considered even in this machine age. For a full bleach a bath is made to carry thirty per cent of dry bleaching powder as figured on the dry weight of the jute. The powder is dissolved in warm water and passed through a screen to remove considerable of the insoluble matter. The yarn previously washed in hot water is entered into the bleaching bath at 140° F., bleached for thirty minutes and raised. A standing bath is maintained for five consecutive batches of yarn, subsequent additions of bleaching powder being but twenty per cent of the dry yarn. The batch is then given a rinse and again raised, given a sour with oil of vitriol using three per cent as figured on the dry yarn, given two final rinses and thrown out. Blue and violet mixtures are sometimes added to the final rinse to improve the white. The same process using less bleaching powder produces the so-called half-bleach. Full-bleach yarns are used for whites in jute carpeting and novelties, while the half-bleach furnishes the ground for tints and bright colors. Jute carpeting which is to be printed is sometimes made with bleached yarn.

Investigating the Value of Paranitraniline for Dyeing or Printing Reds on Cotton Cloth Goods

Trials That Can Interest the Manufacturer—The Detection of Impurities Sometimes Present — The Hydrochloric Acid Solubility Rate and Appearance of the Solutions — Determining the Melting Point—Value for Dyeing Purposes — Computing Value for Printing Purposes

By RAFFAELE SANSONE

ALTHOUGH it is now many years since the several diazotized forms of paranitraniline, known under the names of Benzonitrol, Azophor red, Nitrazol C, Azogene red, Pirazol, etc. were on the market the untreated product finds still a large consumption owing to its great cheapness and its similarity in many respects to the old turkey red styles, so well known for their great fastness to light, washing, chlorine, etc.

The easy application of paranitraniline and the simple process of manufacture have caused the launching on the market of several qualities, among which the consumer has to select that which offers the greatest advantage, not only as regards price, but also for his special purposes. Paranitraniline is obtainable at present as small crystalline needles, or as a fine greenish yellow powder, and the best quality has great purity.

Trials that can Interest the Manufacturer

The number of the chemical tests and small practical trials applicable to paranitraniline that are of interest to the manufacturer of red cotton cloth goods is not large, and are only of value if they permit an exact duplication of the method in use in the works. Such tests and trials should be made to determine if the product under investigation is the best obtainable for the price paid, and that it is free from such impurities as might reduce its dyeing strength or the brilliance of the colors produced later through its means.

The following investigations and trials are of the greatest value:

1. The detection of impurities, and determination of their amount, if present
2. The rate of solubility in hydrochloric acid
3. The condition of the solutions produced with hydrochloric acid
4. The determination of the melting point
5. The determination of the percentage of paranitraniline
6. The determination of the value for dyeing purposes
7. The determination of the value for printing, etc.

The Detection of the Impurities Sometimes Present

Metanitraniline and orthonitraniline are sometimes found as accompanying products in paranitraniline. Metanitraniline can be identified by special tests, while orthonitraniline is found by treating paranitraniline with steam, in which it volatizes, or by boiling with distilled water in a flask covered with white filter paper, that thus becomes yellow. For the last trial the small apparatus shown in Fig. 1 can be of advantage. This is constituted of a light iron stand S, on the top of which is placed a

wire gauge with the thin glass flask F, the top of which is lightly covered with a slip of clean white filter paper fitted on the small copper arrangement D. The contents of the flask are heated by an ordinary Bunsen flame B.

There are however cases where the ortho and meta nitranilines are absent, or only represent a small portion of the total impurities, other much cheaper products being added for securing a higher profit, or for meeting competition. Adulterations, that do not alter the beauty of the red shades produced later, sometimes find employment, and some of them can be detected by burning the organic products and by calcining the residues. A high percentage of ash is a proof of the presence of mineral matter, while the addition of organic adulterants, other than those indicated above, can sometimes be detected through their different solubility in comparison with paranitraniline. Thus dextrine can be identified by mixing a little of the sample under investigation in a test tube with distilled water, filtering off the residue, and examining the clear solution. Some mineral additions can be detected in the same way. Thus the presence of salt can be confirmed in the water solution with silver nitrate and other reagents.

The Hydrochloric Acid Solubility Rate and Appearance of the Solutions

The solubility rate of paranitraniline in hydrochloric acid of convenient strength can be of value in some cases, especially when the trial is conducted against a works standard by using the small apparatus shown in Fig. 2. This is constituted of a light iron frame F, sustaining a double turning arrangement composed of two light copper cover clamps A and B, that can be fitted to the necks of the two wide-mouthed thin-glass flasks G and H. A and B are fixed to short thin steel shafts that are turned in upper bearings through the assistance of pinion wheels c and d, the two pulleys a and b, a thin leather belt, and the minuscule electric motor E.

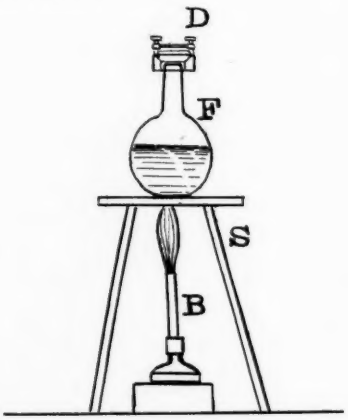

Figure 1.

For conducting the analysis, a measured volume of water at 15°C. is placed in both flasks, after having cleaned them thoroughly from a preceding trial, entering in flask G a fixed weight of the standard paranitraniline, and in flask H the same quantity of the sample to be examined. When this has been accomplished a stop watch is placed before the apparatus and fixed to zero minutes.

By entering both flasks in a water bath heated to the most correct temperature for the trial their contents are prepared for the treatment with hydrochloric acid. This is conducted by emptying out simultaneously in both mixtures, through pipettes of exactly the same size, the necessary quantity of acid for the total solution of the paranitraniline, placing motor E and the stop watch at the same time in motion. The contents of the two flasks is now observed, and the number of minutes is registered with the watch when the one or the other paranitraniline has entered into solution, noting also when the other follows suit. During the trial is observed how the sample under examination behaves with the cold water, the warmed water, and after the addition of the acid, and if after its solution a residue is left, that is then collected and weighed.

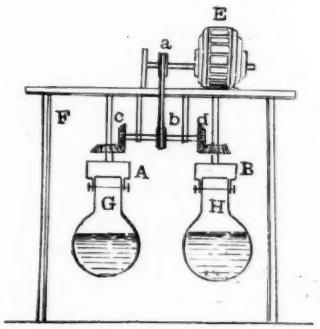

Figure 2.

In this way useful information can be secured. Thus a sample under investigation can give a turbid bath showing the presence of impurities, or a darker bath than that of the standard product, rendering more difficult in some cases the production of the brightest hues of red during the dyeing operations with or without ice.

Determining the Melting Point

The melting point of pure paranitraniline should be 147°C. As the price usually paid does not however permit the purchase of the chemically pure product, that usually found in the dyehouse or printworks never reaches this degree, but remains somewhat under (143-145°C.). The melting point determinations are not difficult to conduct when using the apparatus shown in Fig. 3, that consists of a small beaker B, of about 50 cubic centimeters capacity, containing concentrated sulphuric acid, and fitted with a glass stirrer S. A minute quantity of the substance being investigated is placed in a capillary tube, closed below, which is attached to a thermometer T, by means of a small rubber band. The acid is slowly heated, and constantly stirred, and the temperature at which the substance liquefies and mounts in the capillary tube can be considered the melting point.

Determining the Percentage of Paranitraniline

When the producer of paranitraniline red goods wishes to know the exact percentage of paranitraniline in samples

offered by different dealers, this can be quickly determined with the small apparatus indicated in Fig. 4. Here are to be seen two wide-neck, funnel-shaped flasks F and G, the lower portion of which has the glass taps J and K, while the upper portion is supported by the arrangements H and I, which can be turned whenever required by the small electric motor M, pulleys A and B, the small leather belt C, and the pinion wheels D and E. The whole disposition being fitted on a light iron frame X, the bottom of which is contained in a heavy stone or cement base. Below flasks F and G can be placed a hot water bath for heating their contents, or the two vacuum filters constituted of the glass funnels L and M, and of the thick glass flasks N and O.

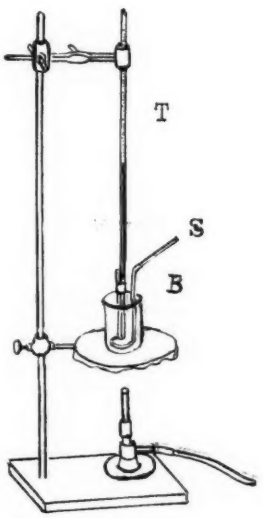

Figure 3.

After entering a measured volume of cold water in both flasks (600 cubic centimeters), and warming to the most correct temperature by placing their lower half in the hot water bath already indicated, 70 grammes of the samples to be examined are introduced in each case, causing them to fall immediately in the warm bath without catching in the necks. The two flasks are then caused to turn, by switching on the electric current to the small electric motor M, and two uniform pastes result, to which are added 110 cubic centimeters of hydrochloric acid at 36°Tw. If a clear solution is not obtained in this way, the two baths are heated further by placing again in the hot water bath. When clear solutions have been obtained, the flasks are left to themselves for one quarter of an hour, and their contents are cooled down to 0°C. by placing them, while they are still turning, in water cooled through lumps of ice as near as possible to 0°C.

The precipitation of the paranitraniline hydrochloride thus follows in a finely subdivided condition and 260 cubic centimeters of a cold solution of nitrite of soda, having 145 grammes of the 95 per cent product in a liter of distilled water, can be added to each flask. Clear transparent solutions should thus result, that after allowing to stand from one quarter to one half hour are made up to 1.250 cubic centimeters by adding cold distilled water up to a white line on flasks F and G. The resulting solutions are then poured through taps J and K into the funnels of the lower vacuum filters, where any residue separated out can be collected and examined.

Separately, 14.4 grammes of beta-naphtol, purified in alcohol, are dissolved in 150 cubic centimeters of boiling water and 25 cubic centimeters of pure caustic soda lye at 36°Tw. are added, and the mixture is made up, when cold, to 1 litre with other distilled water. For conducting rapidly the analysis, 25 cubic centimeters of each diazo solution, prepared as above, and contained in bottles N and O, are carefully measured out, and neutralized with 30 cubic centimeters of 10 per cent acetate of soda, adding after this 15 cubic centimeters of 10 per cent sulfate of alumina.

Twenty cubic centimeters of the beta-naphtol solution are then added, mixing for a short time, and a further quantity of the same is caused to fall in drop by drop, placing continually a drop of a separate beta-naphtol solution on a white filter paper and lowering close to this, through the assistance of a glass rod, a little of the diazo solution, so that the outer portion of the two spots formed meet. The end of the reaction is thus confirmed when no further reddening takes place. From the number of cubic centimeters of beta-naphtol is then calculated the percentage of paranitraniline in the samples examined.

Determining the Value for Dyeing Purposes

When through the above tests and analysis, the most suitable product from a chemical point of view has been found, it is necessary to convince the dyer of its advantage for the purposes of the works, with small practical dyeing trials, intended to control:

1. The shade of red produced during dyeing (bluish, yellowish, etc.)
2. The uniformity of the red coloration on the beta-naphtol prepared material
3. The intensity of this coloration
4. Its brilliance, etc.

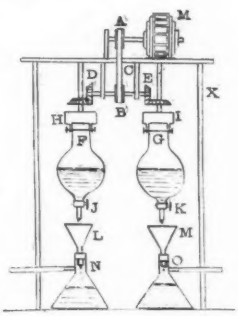

Figure 4.

For conducting the small dyeing trials, samples of ten grammes of plain cotton cloth, with threads of very high

counts, and a smooth uniform texture, are impregnated in a bath containing:

1.5 parts of beta-naphtol,
1.5 parts of caustic soda lye at 40°Bé. and
20 parts of water, to which are added
5 parts of 50 per cent turkey red oil, bringing to
100 parts with cold water.

The impregnation is followed by passing in a fully spread condition across the nip of a pair of india rubber squeezing rollers, under conditions that the samples contain about their own weight in liquid. They are then dried in a small oven heated to 50°C., being divided after this in two parts each of which is treated immediately afterwards for five minutes in a separate bath. One of the baths is prepared with the standard product, and the other with the sample under investigation. The method of procedure being as follows:

1.38 parts of paranitraniline are made into a paste with
3.5 parts of boiling water, and the mixture is dissolved in
3.5 parts of 30 per cent hydrochloric acid, warming further, if necessary, for obtaining a clear solution, and cooling by moving the preparation vessels in a water bath brought to 0-5°C. with additions of ice.

0.75 parts of nitrite of soda crystals are then added while agitating continually, and avoiding that the temperature should rise above 10°C. The bath is then left 10 minutes to itself, being later filtered and brought with cold water to

50 parts, adding just before employment
3.5 parts of acetate of soda crystals dissolved in
6.5 parts of water, and bringing the whole to
100 parts with further water.

For the treatment of the samples of cotton cloth under regulated and convenient conditions the small apparatus shown in Fig. 5 would give valuable results. This contains a shallow glass covered trough T, divided in two compartments of exact size, that is placed in a trough of slightly larger size enclosing a small space all round in which air cooled to 0°C., through a small separate plant, is circulated continually. The last trough is fixed on a cement base of a certain height, and above it are placed two pairs of glass covered bars K and L, which sustain an upper iron case W, with a special mechanism. Through this the small upper creels A and B can be rotated on their axles by simply turning hand-wheel H. In trough T revolve the two glass cylinders C and D, and these and creels A and B contain circular grooves in which are placed four strong endless cotton strings, on which are fixed two of the beta-naphtol prepared samples to be colored E and F.

For conducting the dyeing trials, in the compartment on the right of trough T is placed the bath with the standard paranitraniline, and in that on the left the bath with the product being investigated, tying on the pairs of endless strings two of the beta-naphtol prepared samples. Handle H is then turned for giving these a first steep, and the wet patterns are carefully examined. A second, third, and further steeps are made to follow, observing the changes in each case.

When in this way the required intensity of shade has been produced, the two samples that have received the same number of steeps, and the same time of steepage, are withdrawn and rinsed in clean running water, being then soaped separately, if necessary, and dried. A difference in the intensity of shade of the two patterns can confirm the results of the chemical tests already conducted. Besides this a variation in shade and brilliance can be seen at once when comparing with the dyeing of the standard paranitraniline.

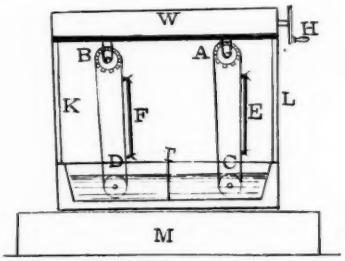

Figure 5.

Determining the Value for Printing Purposes

The printer of cotton cloth requires more complicated trials than the dyer, for here the suitability of the paranitraniline for the production of special articles may have sometimes to be proved, and the colorist must not only have to prepare the color pastes with the greatest precision but may also have to use these by themselves for printing pronounced or less pronounced patterns, or together with other colors of quite different nature, in accordance with the class of articles to be prepared on a large scale.

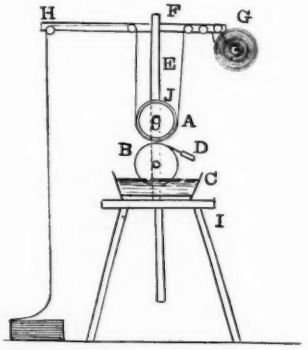

Figure 6.

In this instance the color paste is generally prepared in a double cased iron pan or kettle, lined with a thick layer of glass, or other suitable material, and is printed on short pieces of white cotton cloth of two or three yards length mordanted with beta-naphtol, by using a machine of the type shown in Fig. 6. This is constituted of a heavy wooden table I, on which is fixed a strong pair of iron bars E, held in a parallel position by the upper frame F, and

serving for sustaining the engraved printing roller B and the small pressure roller A, that remains on the first through its own weight.

The printing roller B is moved by a hand wheel, and turns the pressure roller A by means of a pair of pinion wheels. It is supplied in this instance with a doctor D for scraping off all color paste not penetrating in the engravings, and with a color-box C having a double bottom, below which heating can be conducted through the passage of steam. Frame F has at one side the bearings for sustaining a roll G of the cloth to serve as back-cloth in the printing operations, and that is freed of all plaits by passing between three upper opening rollers. This same fabric makes its way out at the other side of the machine by the printer himself, as only a slight length of it is used during each day's work. For avoiding the employment of an endless blanket, pressure roller A is supplied with an india rubber covering J of suitable thickness.

Quality of Textiles and Manufacturing Methods Standardized on Basis of Federal Research

By HENRY D. HUBBARD
Assistant to the Director, Bureau of Standards

THE textile research is a shining example of the control of quality through measurements. The Bureau's chief interest is in those measurable factors which predetermine the quality or fitness for a given use. As every dimension of a key fits a corresponding recess in the lock, so every dimension or magnitude of property in a textile must meet the conditions of service required. Such one-to-one correspondence of measured production to measured need is the basis of successful research.

The potential field for research is limitless—textiles assume an infinite variety of forms—rugs, carpets, garments, bags, flags, sails, plane wings, curtains, handkerchiefs, towels, hosiery, ribbons, surgical bandages, even shoes and hats—each must pliably adapt itself as drapery, covering, container, adornment, health, comfort, protection, what not. Each use presents its problems for the technicians for research, problems the solution of which means human progress in the arts. Their solution creates new utilities, promotes human well-being.

Textile research laboratories of all grades have their hands full of research possibilities. In one research a cotton fabric was developed for mail bags for a certain use where the high quality demanded was duplicated at a great saving. Such problems take the expert to the roots of quality. The ultimate fiber strength and length of individual fiber, the number and twist which, suitably designed into a fabric, give predictable quality.

As the criteria become known it becomes possible to set these measured data into the spinner and loom and invariably reproduce the high quality which the designer made possible. Such reproducibly high quality is made possible by standardizing the process on the basis of the measurements which first produced it. Now comes the next stage, namely, to design predictably, on the basis of the data gradually becoming accumulated on the effect of each production factor.

Cotton duck is an example. In co-operation with the Cotton Duck Association, the Bureau made a technical study of the weave, thread count, yarn size, twist and ply, width, weight, and breaking strength of typical cotton ducks as a basis for developing quality specifications. The complete dimensional analysis was published for the information of the industry. Such specifications sum up fabric design in the field. They control production, hence the Bureau's work of this type is in closest cooperation with the industry concerned.

To set gears for beating raw cotton in cleaning it, we have an unwritten art dependent on the opinion and judgment of the man in charge. To free it from guess work, Bureau research was completed and the results published by the Bureau as computing graphs. These give automatically for each case the set of gears suited to effective beating. Such computing graphs, nomograms, are becoming the controls of process in industry. They embody the skill of the mathematician, the data of research, and permit the novice to apply both in solving his problems.

A related problem was the standardization of hosiery boxes. Eighty thousand tons of box board and cover paper was used annually in packing hosiery. An astounding variety of hosiery boxes was collected—58 for children's hosiery, 39 for men's, and 98 for women's hosiery. Chaos dominated the sizes and the varieties. It was found possible to reduce the variety 80 per cent and save 5,000 tons of box board and cover paper annually and give a better assortment of boxes. A new method was devised for folding hosiery which saves 14 per cent of the box space and strengthens the package as well.

The many resulting economies were estimated by the industry as saving to the industry $3,000,000 a year. At the same time, the total savings from other work on textiles was estimated as having netted the textile industry $28,000,000.

Nine systems of measuring hosiery were found in another Bureau research. The same number assigned to a size might apply equally to other sizes, and in different places the same size was designated by various numbers. The confusion was intolerable. By co-operation a scientific method was devised, tested, and is now standard for the industry. A single method replaces the nine then in use to the great gain of the public and the industry.

The Bureau was able to co-operate in perfecting textile specifications for Army uniforms. Existing specifications included requirements not encountered in service. Tests which do not reproduce conditions of wear tend to limit the dyer in his choice of dyes without advantage to

the service. The Bureau's recommended modifications were largely adopted to the advantage of the service.

Preliminary to such recommendations the expected life of garments was studied in laundering tests. The fastness to laundering was measured. Meantime a test for light fastness was introduced which immediately reduced unsuitable deliveries. In the development of Army fabric, the Bureau by the use of organic acids duplicated the injurious effects of perspiration in discoloring the cloth.

A visit to the textile section laboratory of the Bureau of Standards will be illuminating even to the expert. Here are full experimental mill equipment, a laundry laboratory, so that fibers may be spun, blended, woven into fabric, be subjected to service tests or laboratory research with the object of continued progress in minimizing waste, reducing wear, and prolonging the useful service life of textile products.

In order that all tests of researches may be made comparable, the test laboratory has controlled temperature and humidity. The characteristics of a yarn as to length, strength, and the like might in the course of the moisture changes in the atmosphere alter by as much as 10 per cent. Measured controls of the atmosphere make it possible to compare tests and research results on the same basis, with correspondingly greater confidence in the scientific value of the results.

A current problem of the Bureau is its co-operation in the standardization of sizes of ready-to-wear garments. For example, minimum measurements for boys' blouses, waists, shirts, and junior shirts have been adopted by the industry at a general conference called by the Bureau and under Bureau procedure. Similar minimum measurements for sizes A, B, C and D have been adopted for men's pajamas. The elimination of the E size will simplify stocks.

Similar projects are in process of formulation in co-operation with the International Association of Garment Manufacturers for women's wash dresses, men's shirts, overalls, leather-lined and leather coats. Such standardization establishes a national basis for checking sizes of garments as purchased and will become a uniform guide to production. In the retail trade there will be fewer returns for incorrect size and far less confusion as to size designation.

Another measurement problem is illustrated by the adoption of size designations and basic body measurements for dress patterns, the results of which will be published by the Bureau of Standards under the title "Dress Patterns—Commercial Standards CS13-30."

—*The United States Daily.*

N. A. Long, an alumnus of the Textile School of North Carolina State College, has been made head of the dyeing department for the Beacon Manufacturing Company, Swannanoa, North Carolina. Mr. Long was formerly with the Du Pont Company at Charlotte.

Fire-Hazard Tests of Jute

DURING the past nine years there have occurred 112 fires aboard jute ships plying between Indian and American ports. A majority of these fires occurred after the vessel reached port and during discharge of the cargo. Since 1900 there have been reported 13 fires in jute warehouses, due to spontaneous ignition.

The Marine Underwriters' Committee in co-operation with the Bureau of Chemistry and Soils of the Department of Agriculture and the Bureau of Standards, says the *Technical News Bulletin,* is conducting an investigation of the fire-hazard involved and a research associate has been assigned to work with the two bureaus on the problem. The work is proceeding along the lines of physical and bacteriological determinations.

Previous chemical analysis and tests have indicated that typical Indian jute has no spontaneous ignition hazard from the oxidation standpoint alone. Some heating by bacteriological fermentation does occur caused by cellulose splitting bacteria and resulting in the so-called "heart damage." This group of microorganisms is capable of multiplying in limited amounts of free oxygen and liberate methane and smaller amounts of hydrogen. The possible presence of other gases is being studied.

The present plan is to determine what part the microflora has in the production of secondary products of enzyme activity capable of carrying the temperature above that of the initial fermentation. The temperature and moisture conditions in ship holds give the optimum for the growth of the normal flora found on jute. While the heating thereby produced is not sufficient to cause ignition, the possible formation of unsaturated compounds and occlusion of flammable gases appears to be important.

Large heating chambers that will hold an entire bale of jute have been built and equipped with heating coils capable of maintaining temperatures up to 250 deg. Cen. Means will also be provided for humidity control of the air within them and the sampling and analysis of the gases evolved. The proposed method of procedure will be to hold the temperature of the chamber a few degrees below that of the bale to provide insulation similar to that obtaining for a bale located in the middle of the ship hold. The moisture content will be altered as well as the bacterial flora of the jute bales. Many strains that have been isolated from the jute fibers and grown on artificial laboratory media will be used for the purpose. These organisms have been found to have optimum growth ranges from 20 deg. Cen. to 60 deg.

—*Textile Recorder.*

Proceedings of the American Association of Textile Chemists and Colorists

The American Association of Textile Chemists and Colorists

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Lowell Textile Institute, Lowell, Mass.

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Percival Theel, Secretary, Philadelphia Textile School, Philadelphia, Pa.

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Midwest Section—
Carl E. Bick, Chairman, Real Silk Hosiery Mills, Indianapolis, Ind.
William Bergh, Jr., Secretary, Vassar Swiss Underwear Co., Chicago, Ill.

Lowell Textile Junior Section—
Earle R. McLean, Chairman; Alfred J. Carbone, Secretary.

FIFTY-SEVENTH RESEARCH COMMITTEE MEETING, FEBRUARY 14, 1930

THE Fifty-Seventh Meeting of the Research Committee of the American Association of Textile Chemists and Colorists was held at the Engineers' Club, Boston, Mass., at 4:15 P. M., Friday, February 14, 1930.

The following were present:

L. A. Olney, *Chairman*
Donald S. Ashbrooke
Wm. D. Appel
Wm. H. Cady
H. R. Davies
Carl S. Draves
(representing R. E. Rose)
Walter C. Durfee
Walter E. Hadley
Harry F. Herrmann
E. H. Killheffer
P. F. Kingsbury
Harold W. Leitch
Karl R. Moore
Wm. R. Moorhouse
George A. Moran
C. L. Nutting
Wm. C. Smith
Walter M. Scott
P. J. Wood
Alex. Morrison, *Secretary*

The first part of the meeting was held in conjunction with the council meeting, and the matter of the need of another research assistant was discussed. The council laid this matter on the table until the next meeting.

In connection with this it was decided that the chairman request each sub-committee chairman to draw up a definite program of problems now at hand to be solved and report to him so that a definite plan of work to be done could be presented to the research associate.

A letter from George R. Lockhardt, recently appointed Chairman of Sub-Committee on Rayon, in which he regretfully submitted his resignation from the committee on account of pressure of other business, was read and his resignation was accepted with regrets.

Several other men were suggested as possible chairman of this committee, and the matter left with the chairman to select another chairman of the Rayon Sub-Committee.

A letter from the Atlas Electric Devices Co. was read asking permission to offer as optional equipment on the Launder-Ometer of a tinned copper tank instead of the

galvanized iron tank as is used in the present machine. The Launder-Ometer with the tinned copper tank will be offered at a slight increase in price. The optional equipment was approved, it being understood that the machine with the galvanized iron tank at the original price was to be still available.

Dr. Paul Krais, Director of the German Textile Research Institute, had written a paper to be presented at our last Annual Meeting on Fastness to Light of Dyed Textiles, Its Determination and Standardization, but due to lack of time this was not read but was printed in full in the Proceedings of the Association in the AMERICAN DYESTUFF REPORTER of January 6th, 1930, on Page 33.

In connection with this, Dr. Krais had requested our adoption of the plan for grading of dyestuffs for fastness to light as worked out by the German Commission as outlined in his paper.

Our Sub-Committee on Light Fastness reported that they had checked the colors used by the German Commission in connection with some of their work and found discrepancies between results obtained by the Germans and themselves.

It was voted that Wm. H. Cady, as Chairman of the Sub-Committee on Light Fastness, should prepare a report of his committee's findings in connection with the German standards to send to Dr. Krais. It was also recommended that Dr. Krais be invited to send us dyeings of his standards so that our sub-committee might check them against their dyeings and endeavor to come to a mutual understanding of this matter of standards.

A great deal of time was spent in an informal discussion of a definite research program and in connection with this many points brought out of value to committee men present.

The meeting adjourned at 5:30 P. M.

Respectfully submitted,

Alex. Morrison,

Secretary.

SIXTY-SECOND COUNCIL MEETING, FEBRUARY 14, 1930

THE SIXTY-SECOND Council Meeting of the American Association of Textile Chemists and Colorists was held at the Engineers' Club, Boston, Mass., at 2:10 Friday afternoon, February 14, 1930.

The following officers and councillors were present:

President: E. H. Killheffer.

Vice-President: P. J. Wood.

Treasurer: H. R. Davies.

Councillors: Wm. R. Moorhouse, George A. Moran, Walter M. Scott.

Councillors (ex-officio): Wm. H. Cady, Chairman, Northern New England Section; P. F. Kingsbury, Chairman, New York Section; Prof. L. A. Olney, Chairman, Research Committee.

Secretary: Alex. Morrison.

The reading of the Secretary's report of the Sixty-First Council Meeting was waived.

The financial report of the Secretary was read as follows and accepted:

Financial Report of Secretary—February 13, 1930

Cash on hand Andover National Bank 12/4/29	$265.29
Receipts 12/5/29 to 2/13/30, inclusive:	
Applications (54 @ $5.00)	270.00
1930 Dues (233 @ $5.00)	1,165.00
1931 Dues (2 @ $5.00)	10.00
New Corporate Member	25.00
1930 Corporate Dues	1,650.00
Atlas Electric Devices Co. Royalties	66.00
Guy H. Newcomb—Registration Annual Meeting	206.50
5 Fastness to Light Reports	5.00
Howes Publishing Co. (Reporters)	11.75
Misc. Sales (Reporters)	15.00
3 Pins	4.50
Interest on Deposit	.31
	$3,694.35
Disbursements:	
12/23/29 to Treasurer—Research Fund	$150.00
12/23/29 to Treasurer—General Fund	900.00
12/30/29 to Treasurer—Research Fund	1,075.00
1/17/30 to Treasurer—Research Fund	516.00
1/17/30 to Treasurer—General Fund	600.00
2/4/30 to Treasurer—General Fund	200.00
8 Check Exchange Charges	1.91
1 Check Returned—Bank Closed	5.00
Cash on Hand Andover National Bank	246.44
	$3,694.35

The following were elected to membership:

Active

Altvater, Ernest C., 159 Linden Ave., Irvington, N. J. Chemist and dyer, National Rayon Dyeing Co., 13 Broome St., Newark, N. J.

Anderson, Elmer C., 34 Elm Terrace, South Manchester, Conn. Colorist, research laboratories, Cheney Brothers, South Manchester, Conn.

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Francis, Jr., Carleton S., The Wellington, 19th and Walnut Sts., Philadelphia, Pa. Rayon yarn sales executive, Cannon Mills, Inc., 620 Public Ledger Bldg., 6th and Chestnut Sts., Philadelphia, Pa.

Van Horten, C. B., 2012 So. Main St., W. Salem, N. C. Sales representative, Quaker Oil Products Corp., Winston Salem, N. C.

Ladino, John, 219 Eagle St., Fairport Harbor, Ohio. Chemist, Diamond Alkali Co., Painesville, Ohio.

Lienhardt, Winfield S., 90 Gansevoort Blvd., West New Brighton, Staten Island, N. Y. C. Chemical engineer, Metal & Thermit Corp., Carteret, N. J.

Slayton, C. R., 206 West 6th St., Charlotte, N. C. Salesman, National Oil Products Co., Harrison, N. J.

Corporate

American Aniline & Extract Co., Inc., 141 N. Front St., Philadelphia, Pa. T. P. Key, representative.

The following were elected to membership as of March 3, 1930, a date thirty days after their names were published, provided no objections are received to any of them by the Secretary before then:

Active

Althouse, C. Scott, Bern Township, Berks Co., Pa. Owner, Penna. Dye & Bleach Works, 540 Pear St., Reading, Pa.

Bockius, D. L., 4946 Rubicam Ave., Germantown, Phila. Salesman-demonstrator, Arnold, Hoffman & Co., Inc., Delaware Ave. and Spring Garden St., Philadelphia, Pa.

Brown, Arthur F., 805 W. 29th St., Wilmington, Del. Chief chemist-plant supt., Delaware Rayon Co., New Castle, Delaware.

Cabana, George H., 26 Cottage St., Taunton, Mass. Vat dyer, Mt. Hope Finishing Co., No. Dighton, Mass.

Curtis, Philip C., 71 Chapel St., Saylesville, R. I. Div. supt., Sayles Finishing Plants, Saylesville, R. I.

Ewing, C. W., 60 Manor Road East., Toronto, Ontario, Canada. Textile chemist, Ontario Research Foundation, 47 Queen's Park, Toronto, Ontario, Canada.

Johnson, Harry H., 28 Beach St., Pottstown, Pa. Dyer foreman, Gudebrod Bros. Silk Co., Pottstown, Pa.

Leeper, Durward D., 5 East Main St., Ware Shoals, S. C. Supt., Ware Shoals Bleachery, Ware Shoals, S. C.

Muller, Charles Wm., 18 Bueno Vista Ave., Hawthorne, N. J. Boss dyer and color matcher, Clark Thread Co., Bloomfield, N. J.

Piacitelli, George, 78 Hobson Ave., East Providence, R. I. Colorist, Imperial Printing & Finishing Co., Bellefont, R. I.

Rhodes, George H., Ridge Road, Slatersville, R. I. Chemist, Slatersville Finishing Co., Slatersville, R. I.

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Tarnuzzer, Edmund C., 231 North St., North Adams, Mass. Plant chemist, Arnold Print Works, North Adams, Mass.

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Gilliam, Robert A., Box 266, Gastonia, N. C. Student, North Carolina State College, Raleigh, N. C.

Isom, Wm. F., 7 N. Caldwell St., Charlotte, N. C. Student, North Carolina State College, Raleigh, N. C.

Nelson, Thomas H., 206 East Sixth St., Charlotte, N. C. Salesman, Celanese Corp. of America, 819 Johnston Bldg., Charlotte, N. C.

Stanley, John P., Passaic YMCA, Passaic, N. J. Chemist, United Piece Dye Works, Lodi, N. J.

The following were transferred from Junior to Active membership: J. B. Crowe, Albert F. Johann, Mason M. Turner.

The report of G. H. Newcomb of the Philadelphia Section, as chairman of the Banquet Committee in charge of registration at the last Annual Meeting, showing net returns on registration of $206.50, was read and accepted.

Very careful consideration was given the matter of the meeting place for the Annual Meeting in December, 1930, and it was unanimously voted that the 1930 Meeting be held in Chattanooga, Tenn., and the 1931 Meeting in Boston, Mass.

Correspondence between Howes Publishing Co. and Secretary in regard to handling miscellaneous sales and distribution of Year Book after the members' copies had been sent out were read. It was voted that these be now handled from the Secretary's office.

A letter from Clayton Hoagland, acknowledging vote of appreciation passed at Annual Meeting, was read and ordered placed on file.

It was voted to give the Atlas Electric Devices Co. a special price of 50c on 200 bound copies of the Reports of Light Fastness Committee.

It was voted that the President appoint a committee of three from our membership to work with similar committee from other associations to formulate definite plans for a research bureau, this committee to report back at our next Annual Meeting, in accordance with vote passed at our last Annual Meeting in Philadelphia, December 6, 1929. It was understood that the President and Prof. L. A. Olney, Chairman of Research Committee, would act as ex-officio members of and advisory members to this committee.

The subject of appointment of an assistant to our Research Associate was discussed with the Research Committee and this matter was left on the table until the next Council Meeting.

The meeting adjourned at 4:15 with the understanding that the next meeting would be held March 21, 1930, in New York City.

Respectfully submitted,

ALEX. MORRISON, *Secretary.*

FEBRUARY MEETING OF RHODE ISLAND SECTION

The joint meeting of the Rhode Island Sections of the A. A. T. C. C. and of the A. C. S. was held in the rooms of the Providence Engineering Society, 44 Washington Street, Providence, on Friday, February 14, at 8:00 P. M.

The speaker was Dr. E. M. Shelton of Cheney Bros., South Manchester, Conn. His subject was "Silk—a Field for Research."

An informal dinner was held at Miss Dutton's Green Room, 44 Washington Street, preceding the meeting.

A. NEWTON GRAVES, *Secretary.*

FEBRUARY MEETING OF THE NORTHERN NEW ENGLAND SECTION

The Northern New England Section met at Riverbank Court Hotel in Cambridge on Saturday evening, February 15. Over fifty members and guests were present, of whom forty-three attended the dinner preceding.

N. D. Harvey, Jr., of Carbide & Carbon Chemicals Corporation, spoke on Triethanolamine. John H. Shinkle of the Lowell Textile Institute led a discussion of Mercerizing. H. C. CHAPIN, *Secretary.*

Triethanolamine

By N. D. HARVEY, JR.

Carbide and Carbon Chemicals Corporation

THE general class of alkaline materials is one of the most important commodities in the textile industry. It may be said even that they are the most essential, when we consider the importance of soaps as detergents, emulsifying agents, degumming materials, dye assistants and so forth. Soaps are made with the use of an alkali, while scouring requires a base both for emulsification as well as for saponification. Unfortunately, animal fibers are very sensitive to even small amounts of caustic bases and a close supervision must be maintained over their use in any form.

Recently a new chemical has been introduced possessing an exceedingly low alkalinity combined with the property of forming soaps with fatty acids.

This material, triethanolamine—$(CH_2OHCH_2)_3N$—is a tertiary amino compound in which three ethanol groups have replaced three hydrogen atoms in the ammonia molecule. It is a slightly yellow, odorless, rather viscous, hygroscopic liquid, boiling at 277°-279° C., at 150 mm. Triethanolamine having a pH of about 10.2, forms soaps whose aqueous solutions are less alkaline than those of any soaps at present available. The pH of triethanolamine soap solutions is about 8.6. The oleate, palmitate and stearate are readily formed from the corresponding fatty acid, while many other soaps are compounded with the fatty acids of the common oils. Triethanolamine will not saponify the glycerides of the acids because of its low alkalinity.

When one molecular weight of triethanolamine is added to one molecular weight of a fatty acid, an anhydrous soap is formed by the simple chemical addition of the two. Heating is not necessary in the case of liquid fatty acids, nor does it offer any advantages if utilized. The reaction is mildly exothermic. With solid acids, such as stearic, sufficient heating is necessary to melt the acid and thus permit intimate mutual contact between the two ingredients.

These soaps are comparable in every application with the sodium and potassium base soaps. They are soluble in mineral oil, fatty oils, naphtha, organic solvents and water. Triethanolamine soaps manifest strong detergent and emulsifying properties with the added important advantage of being less alkaline than present soaps, thus insuring against any harshening of wool and worsted material and against fading and bleeding of dyed colors. The oleate is of a consistency resembling ordinary petrolatum, while the stearate is solid. They are completely stable under ordinary plant conditions.

In the form of its soap, its use as a fulling and scouring compound for wool and worsted piece-goods offers many attractive features. Since triethanolamine possesses the ability to saponify fatty acids, assurance is given that the lubricant employed will be completely removed. Lubricants are used chiefly in the form of an emulsion and for stability carry an excess of the particular fatty acid used. Stable emulsions should wash free from the goods in water. Perfect emulsification is difficult and consequently an alkaline soap is used for scouring to completely cleanse the fabric and prevent the retention of any free fatty acid or oil by the cloth. A triethanolamine soap containing excess base serves the same purpose as do sodium or potassium soaps carrying a slight excess of sodium carbonate. The former are preferable because of the softness of the finish and brilliance of the colors which are realized from the elimination of alkalies strong enough to be injurious. Plant tests have corroborated the laboratory indications that triethanolamine oleate produces finishes which cannot be duplicated with other soaps on account of the fulling, softening and lubricating properties of this soap combined with its low alkalinity. Of interest in the formulation of fulling compounds possessing body is the ability of these soaps to stand high dilution with water without an appreciable loss in consistency. In fact, during the first stages of dilution, the resulting product is more solid than is the anhydrous soap.

In the emulsification of oils, fats and waxes, this organic base possesses further possibilities. Emulsions formulated by the use of a fatty acid and triethanolamine are characterized by their ease of formation, their extreme stability, their toleration of temperature changes without separation, the small amounts of base required and the fact that the low alkalinity of triethanolamine allows an appreciable deviation from a specified formula without loss in stability. In forming such emulsions, a procedure somewhat different from that used with ordinary soaps is often followed with advantage. If the required amount of fatty acid be added to the oil and the mixture added to water containing triethanolamine a perfect emulsion is formed immediately. These may be stocked in concentrated form and diluted as desired. With oils, oleic acid is used, while stearic acid is preferred with the waxes. In many cases, the particular material to be emulsified con-

tains sufficient fatty acid and thus a further addition is unnecessary. For instance, linseed, neatsfoot and blown castor oils are readily emulsified by adding the oil to a triethanolamine solution in water.

A second type of emulsified oil may be compounded with this base, namely, the "soluble" products which are clear, but emulsify spontaneously when poured into water. In this case, the fatty acid and base are added to the oil to form a clear solution. Such oils have a tendency to curd when added to water and consequently the use of a mutual solvent or coupling agent is almost essential. A material soluble in the oil and also water soluble increase the dispersion of the oil in water thus reducing its curding tendencies and enhancing the stability of the emulsion. Among such agents would be included the monoethyl ether of thylene glycol or Cellosolve, the monobutyl ether of ethylene glycol or butyl Cellosolve, the monoethyl ether of diethylene glycol, or Carbitol, ethyl and isopropyl alcohol, Hexalin, Tetralin, and others.

As is well known, emulsions are used widely in the textile industry for lubrication of fibers and yarns, for silk soaking, throwing, knitting, finishing and softening of all kinds. In such processes, triethanolamine opens up a new field in that its low alkalinity permits a more complete neutralization of oil acidity than do the common alkalies. Sulphonated oils may be completely neutralized to eliminate corrosion difficulties so common to the presence of free acidity in oils. Sulphonated oils are desirable in that they are water soluble and thus require no emulsification. They are excellent softeners and dye assistants, and thus by allowing their complete neutralization, triethanolamine extends the field of their possible applications. This feature of the material is of value in the formulation of knitting oils for natural silk, as in this case, free acidity corrodes the needles while alkalinity loosens the silk gum thus allowing it to flake and clog the needle eyes. An oil which is slightly basic with triethanolamine will not corrode nor will it loosen sericin.

Triethanolamine itself has strong penetrative and softening powers, which may be utilized to advantage in carrying soaking, lubricating and finishing oils into textiles to enhance their processing and to increase the softness of the finished fabric.

As penetrants and wetting-out agents triethanolamine soaps are comparable to those with sodium or potassium base, and possess equal limitations. Soaps in themselves are not suited for use in hard or acidified water because of the formation of insoluble metallic soaps and the breaking down of the soap. Excellent penetrants are being compounded utilizing the ability of triethanolamine soaps to lower surface tension and incorporating with them other materials such as sulphonated oils and solvents of the chlorinated group or glycol ethers. Such materials compare in efficiency very favorably with the sulphonated naphthalenes, phenols and cresols, and are somewhat more economical.

Triethanolamine soaps, more particularly the oleate, are rather unique and exceedingly important in that they are soluble in a great variety of solvents. Mineral lubricating oils containing a slightly alkaline triethanolamine oleate are readily washed from fabrics or yarns without resort to chemicals which tend to harshen the material or have deleterious effects upon dyed colors. Butyl Cellosolve increases the solubility of the alkaline soap in the oil. Soaps carrying free fatty acid are corrosive. More important, however, is the solubility of triethanolamine oleate in a solvent such as naphtha which finds wide application in spotting and general cleaning. The solvent powers of naphtha are limited to oils, grease, tar, and impurities of a similar nature. It is well known that the incorporation of a soap with a small amount of water and a second solvent to hold the various materials in solution, will greatly enhance the general detergent properties of the compound. Fatty acids are soluble in naphtha. The soaps formed by complete saponification with sodium or potassium hydroxide are insoluble. The use of a material such as Hexaline increases this solubility, but the presence of free fatty acid is still essential for complete solution. Due to the neutrality of triethanolamine oleate as compared to sodium or potassium oleate, the former is soluble when completely saponified. In low concentrations such as below 3 per cent, it is insoluble. However, solubility is obtained by the use of 10 per cent to 20 per cent of ethylene dichloride, Cellosolve, or butyl Cellosolve. With the latter, as much as 10 per cent water may be incorporated without the development of a cloudy naphtha solution. Amounts as small as 1 per cent of the mixture in naphtha are completely soluble. Thus the use of naphtha solutions of a completely saponified triethanolamine oleate precludes the development of rancidity or stains from any residual fatty acids. Triethanolamine has been found to not only impart greater detergent powers when used in naphtha solution but also restores dull colors to their original brilliance. A further consideration of economic interest is the fact that one pound of totally saponified soap is more efficient than one pound of a soap containing excess fatty acid simply because free fatty acid has no detergent properties.

With the popularity of cellulose acetate silk growing rapidly the investigations concerning proper dyeing methods for the material becomes doubly important. Since celanese silk is rather resistant to dyeing under ordinary conditions, a procedure has been necessary in which by chemical means the textile is rendered more receptive. Also a special line of dyestuffs has been developed exclusively for cellulose acetate silk. Saponification may

be brought about by the use of alkalies, in which case cellulose is regenerated. When carried out under ideal conditions, the process is controlled in such a manner that only the surface is saponified. The character of the silk is not materially altered. The result is that this small amount of regenerated cellulose, being receptive to ordinary colors such as the direct or substantive type, is dyed without any perceptible alteration of the main body of the fibers. A second method which is employed is that of utilizing the solvent properties of certain organic chemicals. The actual dissolving is reduced to a minimum with the result that mere swelling takes place without any actual solution. Suggested materials in this class would include butyl Cellosolve, Cellosolve, methyl Cellosolve, diethylene glycol, Carbitol, and thio diglycol.

Of the alkalies available for partially saponifying cellulose acetate most are too strong and the process is controlled with difficulty. Triethanolamine, because of its low alkalinity, is of great interest in this respect as dangers of over saponification are greatly reduced, while varying amounts of triethanolamine do not alter the pH of the solution.

The incorporation of varying amounts of triethanolamine soaps with a sodium or potassium base soap, produces a resulting compound of less pH than that of either soap alone. That is, triethanolamine soaps act as buffers for caustic base products thus reducing the hazards resulting from their use on wool, worsted, and silk, and improving the final finish obtained.

The possible applications of a base such as triethanolamine are very extensive and diversified. Investigations to date have been quite preliminary, but the information available forms an excellent guide and stimulus for the opening of new fields.

Discussion

Mr. Cady: Is triethanolamine suitable for the degumming of silk?

Mr. Harvey: No. A pH of about 10.0 seems essential. Triethanolamine has a pH of 10.2, consequently when combined with fatty acids to form soaps, the pH drops to about 8.6 which is too low for degumming.

Mr. Cady: Is it recommended for the saponification of cellulose acetate?

Mr. Harvey: We have done some work on this. Our results indicate interesting possibilities but is not sufficiently advanced for practical recommendations.

Mr. Brady: Is it used as a rule as an alkali or only combined in soaps?

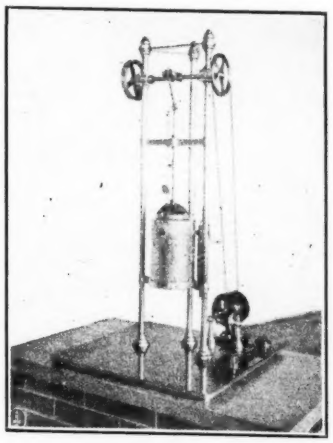
Mr. Harvey: Triethanolamine is generally used for scouring in the form of its soap. Such materials are of interest because of their neutrality. In conjunction with sodium or potassium soaps triethanolamine alone would offer no particular advantages as an alkali, but a triethanolamine soap does buffer the action of sodium soaps to lower the alkalinity of the latter.

Mr. Brady: What is the cost?

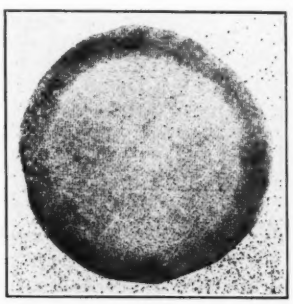
Mr. Harvey: It has dropped from $1.25 to 40 cents. Price is governed by volume, falling with increasing usage.

LABORATORY WASHING MACHINE USED IN POLAND
(The Pralka)

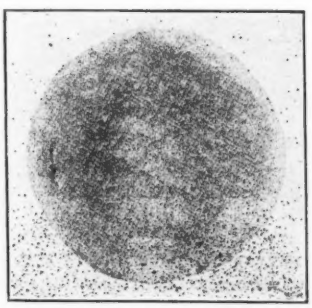
In the February 17th issue of the AMERICAN DYESTUFF REPORTER, Page 128, there was published a description of a laboratory washing machine recently received from Poland. The description stated that the apparatus had been approved by the Polish Fastness Commission. For this reason it was thought that it might be of interest to some members of the A.A.T.C.C. Unfortunately the illustrations which are quite essential to an understanding of the apparatus were omitted. We are therefore publishing them at this time, and readers are requested to refer back to the above mentioned issue of the REPORTER for the actual description of this apparatus.



The Pralka.

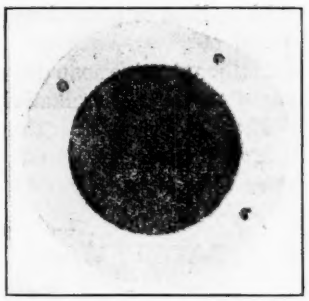


Photograph of a washed sample.



Photograph of a sample the shade of which became darker with the soap.

Photograph of a sample of white fibre washed together with a sample dyed with a color which did not run on to the white fabric.



Photograph of a sample of white fibre washed together with a sample dyed with a color extending on the fibre of the white fabric.

APPLICANTS FOR MEMBERSHIP

Active Membership

Covington, R. M., salesman-demonstrator, Du Pont Co., 715 Provident Bldg., Chattanooga, Tenn. Sponsors: Lee Roy Hiller and R. S. Wheeler.

Perry, Edward T., assistant chemist, Lincoln Bleachery & Dye Works, Lonsdale, R. I. Sponsors: E. A. Wilkinson and Ernst E. Hanke.

Staples, R. C., salesman, Mathieson Alkali Works, P. O. Box 483, Chattanooga, Tenn. Sponsors: Ben R. Dabbs and Lee Roy Hiller.

Tillinghast, Edward S., chemist and assistant manager, Fairforest Finishing Co., Spartanburg, S. C. Sponsors: John C. Cosby and Alex. Morrison.

Junior Membership

Jones, Bliss M., student, Lowell Textile Institute, Lowell, Mass. Sponsors: L. A. Olney and John H. Skinkle.

Richardson, Hiram L., laboratory assistant, Lowell Bleachery, Lowell, Mass. Sponsors: Stephen F. Howard, Jr., and Alex. Morrison.

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Wm. H. Barnhardt, Former Address: 1116 Johnston Bldg., Charlotte, N. C.

James W. Entwistle, Former Address: P. O. Box 22, Hartsville, S. C.

John Fisher, Former Address: Rochelle, Ill.

Frank Ed. Howard, Former Address: Box 48, Wellford, S. C.

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Charles Thompson, Former Address: 206 South Harrison, Kankakee, Ill.

Geo. G. Wallace, Former Address: P. O. Box 1572, Atlanta, Ga.

ASSOCIATION BADGES

The lapel button badge illustrated herewith is worn by members of the American Association of Textile Chemists and Colorists.

The three "rings" are enameled in red, yellow and blue, respectively, and the initials and border are brought out in gold. The general effect is exceedingly attractive.

Badges may be secured at $1.50 each by addressing the Secretary.

ALEX. MORRISON,
American Woolen Co.,
Andover, Mass.

AMERICAN DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
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Directing Editor

WILLIAM HOWES COLLINS
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Published biweekly by
HOWES PUBLISHING CO., INC.
440 Fourth Avenue, New York City

A. P. HOWES, President E. S. PREDMORE, Secretary

Subscription price $5.00 per year; Canadian $5.50; foreign $6.00

Vol. XIX March 17, 1930 No. 5

THE CARTEL MOVEMENT

THE large foreign Cartels upon which was focused so much attention of recent years appear to have lost their vogue in so far as general American interest is concerned. Perhaps the dwindling of excitement on the part of the average person may be conveniently assigned to his preoccupation with the more immediate and impressive developments which are looming so great on this side of the Atlantic. The day of amalgamations and mergers is undoubtedly still in its infancy. When changes involving millions of dollars and thousands of workers frequently occur almost over night, it is only natural that they should command primary consideration.

Yet it is just as well to realize that Europe has had her way of meeting the constantly increasing demands and requirements of twentieth century business interests. She has opened up new and impressive fields of trade by means of the Cartel movement—a development which is strictly prohibited by Federal statute here in this country. It is scarcely an exaggeration to estimate that more than half of Continental commodity trade is carried on through such channels.

Up until last year every fiscal period had been marked by a very considerable advance abroad in the spread of this method in production and sales. Then in 1929, for some occult reason, there was no significant development in Cartels over that of the preceding year. True, some few renewals were recorded, but practically every attempt toward the establishment of a new Cartel field was greeted with scepticism and finally failed of its object. No broad explanation of this has been forthcoming, and the few actually proffered were more in the nature of apologies than reasons.

However, one must not loose sight of the fact that despite this apparent sluggishness the Franco-German Dyestuff Cartel originally agreed upon for two years in 1927, was last year renewed for a five-year period. Still more important was the joining up on the part of the principal Swiss interests, which under a special dispensation continue to retain their previous foreign sale organizations.

According to estimates made by the European press, this new three-nation Cartel controls close to ninety per cent of the Continental and seventy per cent of the total world production of dyestuffs.

The continued growth of such an international organization cannot be considered a mere bagatelle.

FOR TRUTH IN BUSINESS

PERFORMANCE, not mere promise, in the betterment of business conditions naturally challenges attention, and an organization which by its very nature is daily endeavoring to stamp out corrupt practices which undermine public confidence in industry deserves not only public commendation but that support which translates itself into tangible assistance.

At the end of its fifth year of service to the merchandising field, the Better Business Bureau of New York City has rendered an account of its stewardship. It has published under the title of "Facts Then Action," a booklet describing some typical work that the Bureau has carried out during that period. It is interesting to note how many different industries, both directly and indirectly, have been helped by the constant watchfulness on the part of the Bureau and its indefatigible work in following up the various leads which it accumulated.

In the last year alone there were more than six hundred instances of information-service rendered which tended definitely to prevent the occurrence of further inaccurate advertising and other distrust-breeding practices. The Bureau cooperates with both Federal and State authorities and also with other Better Business Bureaus, Chambers of Commerce and similar agencies seeking to protect the unwary and inexperienced. It helps to set and maintain high business standards.

Retailers who offer to the public articles which had been spuriously labeled as "Fast to Light" and "Fast to Washing" were discovered and told that it would be wise for them to discontinue such procedure. In the vast majority of cases, it is said, there was immediate acquiesence, and the matter did not have to be placed in the hands of the authorities.

Such efforts cannot help but react favorably upon the producer of genuinely fast dyes and finishes. The confidence of the everyday buyer is being cultivated so that he may be certain of the label which he finds on goods.

The Better Business Bureau does not limit its activity to any particular trade. It stretches forth its hand to protect wherever it feels that protection is needed. It more than justifies the name which it bears.

MONEY FOR METERS

PERIODICALLY there is an announcement which recalls the fact that there still is pending before Congress contemplated legislation introduced originally several years ago by Representative F. A. Britten of Illinois and others to authorize the Department of Commerce "to establish commodity quantity units for general use in merchandising after 1935, standardizing the yard to the meter, the quart to the liter, the pound to 500 grams, decimally divided.

The proposal aroused no small amount of feeling when it was first brought to the attention of the country. There were many arguments advanced in its favor, particularly on the ground that the United States along with Great Britain stood alone against the rest of the world in maintaining arbitrary standards of weights and measures. From the other side came the assertion that the inconvenience and loss would outweigh any advantages to be gained by the change. Several interests ventured to suggest that the cost would be tremendous, But there were few figures presented to substantiate the claim.

Recently William E. Bullock, Secretary of the American Institute of Weights and Measures, in New York, estimated that were the United States to pass such a law it would cost manufacturers $30,000,000 spread over a period of ten years to substitute the metric units for those in use today. Added to this, according to Mr. Bullock, would be an item of an average of $230 per head for each of the workers in the country—this for the purpose of metric tools. Then, finally, there must be the expense of the enforcement of the new units and standards by the Government. The Bureau of Standards would have to recruit and maintain a staff of some ten thousand officers, and calling the average compensation $1,500 per man annually, the wages would total $15,000,000 each year.

These figures seem rather large, even in a day when a good deal of talk of millions is bantered about. If they are approximately correct, perhaps it might be well to put some thought on them. There is particular interest—or should be—in these for manufacturers who certainly would have to shoulder some of this cost. The change may be inevitable; and if so, the cost must be met. But, at any rate, the matter calls for weighing—maybe in pounds, maybe in grams.

Random Thoughts on Research

Starting Big—Duplication of Effort

THE bigger and better is the usual saying, but must we start big to be successful? Not necessarily. The idea that it will not pay to start research on a small scale is ridiculous, when we see so many great businesses that have had to start small and perhaps turn over a little profit all the time.

Although it is preferable to begin right, which is certainly on a rather large scale, there are other ways to get research started. We have examples even in textile work where a teacher in a university or technical school has been able to do a great amount of useful and sometimes very fundamental research.

Schools, too, have sometimes the less laudable desire to do something, ostensibly for an industry, but actually, it would seem, for their own publicity. Such spectacular work is likely to be superficial and of little actual use to anybody and is not considered here.

There would be no sense in planning out a large number of problems and assigning them to individuals scattered here and there all over the map, to teachers and industrial men. According to all accounts, most teachers are too busy teaching; have to piece out a modest salary by outside work; or have not suitable or sufficient help and therefore could not contribute very effectively to a research program. The other men have too much also to do.

On the other hand, a man with time and a group of earnest students of post-graduate ability could really accomplish something on almost any one of a great number of problems. Therefore, if at the start, the necessary buildings, library and other facilities are not within reach, why cannot a central administrative body establish chairs of textile research or textile science at selected schools where there are suitable laboratory facilities? The incumbent of such a position should be free from all but a nominal teaching burden, and free from the necessity of depending upon outside consulting work. He should supervise research work on selected problems, and be provided with students who could take advanced work, probably physics, organic or physical chemistry based on his main problem. More continuity might be maintained by retaining also one or more workers on the fellowship system, which is proving so successful and becoming more and more popular.

There might be a good deal of sense in deliberately starting the whole program in this general manner. It would give an indication how the work would develop, would almost automatically point out key men for the organization, and would train a group of students from which could be selected research workers.

It is understood that at least one of the British research associations has operated fellowships at universities, partly with the idea of preparing men for more responsible work in the organization.

The fact remains, of course, that the single large close-knit body would be most effective.

"Avoid duplication of effort" is a modern slogan that can be easily overrated in research. Probably every research worker has at some time tried to extend work published by someone else, and had to repeat all or part of it. Time and again it is found that one will not come out the same. The writer recalls at the moment the action of a very concentrated solu-

tion on cotton. The published work does not agree with his own experience. The reason is evidently very simple, that the solution did not actually wet the cotton in the original experiment.

This simple fault vitiates the results of a very difficult piece of research which is otherwise very valuable. The avoidance of duplication of effort might have led to its acceptance, as it did for a time, and provided some very puzzling things that had to be harmonized. Published research is full of errors and defects, some of which may have been entirely unavoidable at the time the work was done.

In general, it is a very good thing if the same piece of work can be going on in two places independently. The results are almost sure not to be in complete agreement, and the sooner this is known and can be checked back and corrected, the better, so that final publication will be correct.

If you repeat a piece of your own work you will almost certainly do it better the second time; if you do it only once you can see a dozen ways in which it can be improved next time. It is the same with everybody else.

A reasonable amount of repetition and checking is desirable in almost every piece of work in order that conclusions will be as correct as possible. Much of this checking is done automatically, in a sense, in a large group of workers, and the fact that it is really done may be lost from sight.

If organized research is being done at independent centers it is important that control tests be made to insure that the methods and results are all consistent. This need not all be regarded as useless repetition for it has a real value in confirming and substantiating the results obtained.

I Am A Chemist

By Berton Bellis

I have provided work, brought about prosperity, laid the foundation of the fortunes of many people and sowed the seed of commercial prosperity—broadened commerce—and improved the material conditions of man himself and those who care for him and his possessions.

I am one of the oldest of sciences, the first to be recognized and utilized by man.

I am of the profession that has given many martyrs to humanity's cause of peace, progress and better living conditions.

I am always investigating—experimenting—and trying to expose the hidden secrets of the different material elements and remove all doubts to the goodness and wisdom of God, the omnipotent creator of all things.

I am always at the mercy of burning acids, explosions, diseases, blindness, and death.

I am the creator of the laboratory that guards man against famine, disease, destruction, and untimely deaths.

I place the various ingredients of the universe under the microscope, and in the test tubes, and am at home with the living germ—or the units of matter, the molecules, the truants of the naked human eye, the atom and the electron.

I take nourishment from the atmosphere and plant it in the arid soil thereby enabling man to cultivate and raise a greater abundance of food.

I create and make the synthetic materials to take the place of materials vanished from the earth.

I find the evidence of crime in the test tube and under the microscope—and am a great factor in criminology.

I turn the forests into pulp from which paper is manufactured and I make materials into ink and refine the steel of which printing presses are made, thereby helping man to collect and publish the latest news and promote education and learning.

I invent and make the paint with which the master artist touches the canvas with his magic brush and produce almost living, speaking pictures.

I am of the profession that has caused many a man to go to an untimely grave because of the lack of knowledge and appreciation of my principles and secrets.

I am the one who has found a monument in man's living conditions that have been constantly improved by my comrades for ages and eons.

I open new countries in the arid districts and destroy pests, check the ravage of pestilences, and turn the barren and unproductive lands green with abundant verdure.

I make the ingredients for the healing balsam, the drugs, the vaccine, virus, the serum, and all other nostrums that relieve sick and distressed humanity.

I make the coloring for man's robes and beautify the smile of "my lady" fair and make perfumes of the earth that rival the most fragrant and bewitching rose that the cultivation of man ever produced.

I lengthen man's span of years by purifying the water that he drinks and enabling him to make his foods more wholesome.

I account for action and reaction—composition and decomposition—and all changes made in the workings of the natural forces and matter.

I can make war and carnage so destructive and terrible that mankind will be compelled to live in peace because if he does not, the entire race will be annihilated.

I am man's benefactor for long life, peaceful pursuits, foods in plenty, and the stimulus to traffic and commerce.

As man travels from the cradle to the grave I am his benefactor, helper, and conserver and even preserve his mortal body for future generations and history.

I AM A CHEMIST. —*The Crucible.*

The Dyeing of Artificial Silk

By GEORGE RUDOLPH

Specially Translated from Kunst-Seide 11,313 (1929) *for* THE AMERICAN DYESTUFF REPORTER

WITH this material, in deciding upon the method of dyeing, we have to be guided by the nature of the fiber, and by the required degree of fastness of the dyestuff. Some kinds of fiber can be dyed with dyestuffs not particularly fast, some must be dyed with absolutely fast colors. In what follows, it may be pointed out just what classes of dyestuffs come into consideration for Viscose or Glanzstoff, and what are the chief requisites in fastness-properties which can be satisfied.

A certain number of basic dyestuffs must be employed, in order to obtain specially clear, lively tones. Although, as is well known, the fastness to light of these dyestuffs leaves something to be desired, yet the fact should be no drawback to their use, for the desired clearness of the tones cannot be attained except by the use of the basics. We can certainly increase the light-fastness of some of the basic colors by after-treating with copper, but in this after-treatment there results almost always such a change in tone, that an exact matching of samples is impossible, and we therefore prefer not to after-copper. Recently, after-treatment with Auxanine B has been recommended for the purpose; in this case only a slight, unimportant change in tone occurs. But the good fastness to light attained by use of this agent is diminished or destroyed by after-rinsing, or particularly washing. From its general behavior, it is plain that the treatment with Auxanine B comes into consideration only for such goods (e.g., for decorative purposes, masques, etc.) as are not to be subjected to washing.

Light and medium tones can be dyed directly, with addition of a little acetic acid, but the dyeings as produced are in value far below those carried out with tannin-tartar-emetic mordants, in fastness to water and washing; and, furthermore, much dyestuff remains unexhausted in the dyebath. The dyestuff is also not fixed sufficiently. In most cases we therefore dye upon premordanted goods.

Now, we know that the basic dyestuffs rub off more or less badly, according to the depth of dyeing. This difficulty, with the possibility of its being obviated, is often brought up to the correspondence columns of more than one textile journal, and about the same proposals for its avoidance are made each time. It may be well, then, to say a little more regarding the matter; if we carry out experiments in mordanting on only the small scale, i.e., in dye-beakers, with various grades of tannin, and then after-treat all the tests with the same amount of tartar emetic (half as much as is used of the tannin) in order to fix the tannin, we can make some interesting observations when we come to dyeing up the swatches. We shall find that in case of a premordanting with pure, good tannin, the dyebath will be as good as exhausted, even with deep shades. On the other hand, when the mordanting is done with a poorer tannin, the bath remains more or less saturated with the dyestuff; in other words, it does not exhaust well. Thus, by mordanting with pure tannin, the dyestuff is fixed more satisfactorily, and so is less liable to rub off. What grade of tannin may be used in practise is a question of price, and does not come within the limits of this paper.

According to the degree of fixation of the dyestuff, the fastness to water and to washing is increased along with the fastness to rubbing. All three values, also the fastness to over-dyeing, are notably increased through an after-treatment of the dyeing with tannin-tartar-emetic. This after-treatment may take place in the bath first used for mordanting, or, with small runs, in a fresh bath. If good fastness to water, washing, and especially over-dyeing, is demanded, the after-treatment simply must follow. If the proper basic dyestuff has been used, such a dyeing will bear the washing, fulling, and also over-dyeing (if this is needed) which is customary for woolen piece-goods.

In place of the tannin mordant, Katanol W is also used, and with this agent, we can work more rapidly, and so save time. If this product is employed, the same after-treatment, in old or fresh bath, can be resorted to for increasing the fastness to water and to washing.

Now, when we consider the fact that the appreciation of color is strongly developed among people in general ("die Farbfreudigkeit der Massen" is a little stronger), and a number of kinds of material are worn for only a reasonably short time, we need not feel any surprise at the still considerable use of some of the basic dyestuffs, troublesome as the group of basics is generally considered to be.

In comparison with the basics, however, the substantive dyestuffs are much more widely employed. Why this should be the case is easy to explain; we have at our disposal a considerably greater number of dyestuffs of all shades, and the method of dyeing is the simplest of all. Beside this more simple mode of working, in comparison with the basic dyestuffs (no time is lost in mordanting), the possibilities of shading are greater, and we can attain a good to very good degree of fastness to light, if we

select our dyestuffs with judgment. The dyestuffs which are most fast to light are so constituted that the more exacting demands can be met. Now, although all substantive dyestuffs are dyed upon artificial silk in a greater degree of fastness to water and to washing than is possible with cotton, yet they cannot be considered as strictly fast to washing. But there exists, nevertheless, a whole series of these dyestuffs which will withstand a reasonable or careful washing, as practical experience shows. There are careful and careless laundresses. For the latter, only the absolutely fast dyestuffs are good enough. Fastness to over-dyeing as mentioned under the basic dyestuffs, is a quality not possessed by the direct colors. If this requirement is to be met properly, we have to choose only certain dyestuffs, and after-treat the dyeings from them with chrome, chrome and copper, or formaldehyde. This after-treatment is simple and takes little time; it usually requires about one-half hour. Simultaneously, the fastness to washing is essentially increased. Formaldehyde, which alters the tone of the dyeing only very little, is the agent most commonly employed. Some dyestuffs which yield bright-colored dyeings work well with the formaldehyde after-treatment, but it is most largely used for blacks. The increased fastness to washing brought about by formaldehyle is diminished again by repeated washings. The copper after-treatment is used with some dyestuffs only to increase their fastness to light. It is unfortunate that after-coppering alters the tone of the dyeing, so that dyeing according to sample is made difficult. Although there are some dyestuffs whose fastness to light is notably increased by the copper-treatment, we may assume that this treatment is to be avoided where it is a question of increasing fastness to light only. We avoid it because we possess a sufficient number of dyestuffs which show, when dyed directly, the same good fastness to light as the after-coppered ones.

Artificial silk dyeings are often brightened with an acetic acid bath after dyeing, so that the dyestuffs must be fast to acid or brightening, to avoid change in tone. It is not a hard task to select such dyestuffs; there are plenty of them.

When fastness to washing is a requisite, the Diazo dyestuffs are employed. Of these, we possess handsome yellows, oranges, a great many reds, scarlets, bordeaux to browns, different blues, violets, greens, and blacks, which latter serve also for grays. With these dyestuffs a great deal can be done. Among them are some products, in satisfactory number, which endure well the pretreatment and finishing processes customary for woolen goods, and over-dyeing also, when used for effect-threads and woven up with wool. Among these Diazo colors there are some which possess poor fastness, others which possess good fastness, to light. Their suitability for a given case can be decided by their fastness-values.

The dyeing of these Diazo colors is carried out as is customary for substantive colors (as far as the padding is concerned). After "dyeing," we rinse and diazotize in a cold bath for 20 minutes, then rinse again, and develop (in the cold again) during 20-30 minutes, with the developer recommended for the color in question. It is necessary to be sure that the development take place as soon as possible after the diazotization, because if the diazotized dyestuff-goods lie around for a while spots are easily formed, as a result of the decomposition of the diazo-compound. Very particularly must the goods be protected from sunlight. These sources of trouble do not come to pass if development follows directly upon the diazotization. The developed color, after rinsing in cold water, is best washed in a soap-bath at about 50° C., through which the color is made more pure, and freed from the developer or any scum, etc., adhering to the goods. In all tests for fastness to washing, which may be carried out on the small scale, the above should be kept in mind. If this is not done, a dyeing which is really of good fastness to washing when done properly may be found to be actually of only moderate fastness.

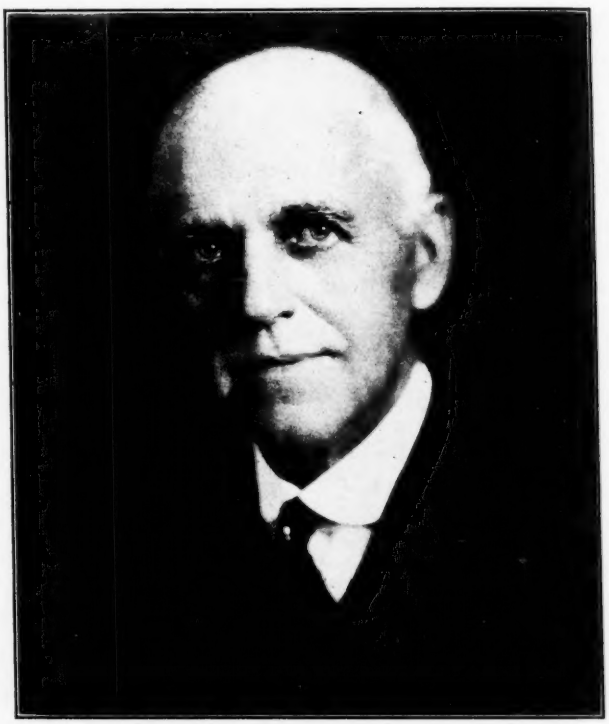
The sulphur dyestuffs are used only for dyeings which are required to be more fast to washing, fulling, over-dyeing, and to light, than for ordinary cases. We may assume that dark tones, which are to be frequently repeated, will be dyed with the sulphur dyestuffs. We refer particularly to dark browns, blues, greens, and blacks. Dyestuffs are used which do not need too much sodium sulphide for dissolving and dyeing; less soda is added (about one per cent) than is customary for cotton, and not more salt than is used for substantive dyestuffs. In dyeing cotton with sulphur dyestuffs, we in most cases let the bath come to a boil, then enter the goods with the steam turned off, and dye without further treatment, while with artificial silk it is beter, even necessary, not to raise the temperature above 50° C. This is advisable, in order to avoid danger to the material. For levelling, one to two per cent of Monopole Soap, or twice the amount of Monople Brilliant Oil, is added. If we make preliminary trials (and this is absolutely necessary with the sulphur dyestuffs, especially if we are using new stocks of the dyestuff) we can expect that by the most exact work on the small scale in our trial dyeings (amounts of dyestuffs and additions, temperature, and bath-ratios) our results will correspond when worked out on the large scale.

We can shade the sulphur dyestuffs, which do not exactly correspond with a different stock of the same product, in a fresh bath, with basic or substantive dyestuffs without trouble. The sulphur dyestuffs act as mordants for basic colors, and so the basics will take well in small amounts, if we use substantive dyestuffs for shading, some salt is added also. Naturally, the dyestuffs are modified in their fastness-properties according to the amount of material added.

Mention has been made of the Indanthrenes often before, but it may be worth while to call attention again to this class of dyestuffs, without going deeply into any exact methods of working. We have to regard these dyestuffs as the high-water mark among the different classes of dyestuffs. In the advertised descriptions of Indanthrene fast-dyed goods we generally read "guaranteed fast to light, washing, and weather." It may be possible to ignore the question of whether this guarantee can be held to be valid for the unlimited light-fastness of a light shade, but in any case the indanthrenes stand out as the best, absolutely, for mode-tones, when used in correct choice and mixture.

One or another dyestuff may prove not quite as good as desired in the fastness-properties, for example, in fastness to chlorine; yet the general impression which they give is very good. There are some Indanthrenes which level well, others which level poorly. With the latter, addition of glue, Dekol, Monopole Brilliant Oil, or perhaps a lower bath-temperature at the beginning of the dyeing, etc., are to be recommended. If anyone desires to take up the dyeing of the Indanthrenes, he simply must study the special literature upon it before beginning actual work. The beginner must be careful that, in dyeing of yarns or piece-goods in open vats, baths which are not too short should be employed. The goods should have plenty of room in the bath, so that they can be worked freely. Though in a longer bath more caustic and more hydrosulphite, and perhaps more dyestuff, have to be used, yet this is not to be considered, in comparison with the more satisfactory quality of the dyeing. The hitting of the exact shade, especially with mixed tones, is with vat dyestuffs by no means so simple as, for example, with the substantive dyestuffs. Therefore, it is only good judgment for some dyeing firms to refuse to guarantee a "hair-sharp" matching of a certain desired tone. We have to remember that the dyer is trying to do his best, as he is of course forced to do because of competition. Slight differences in shade are mostly unimportant and not worth criticism, if in other respects the fastness-properties are satisfactory or excellent, as will be the case with Indanthrenes.

In conclusion, let us add the following: With the considerable amounts of artificial silk now being worked up commercially, a great deal of waste material is being encountered, in both the weaving and in the cutting up of goods for garment-making. In earlier years, in the wool industry, and even now, the waste and the new goods produced from it were called by the name of "art wool." More recently we are speaking rather of "old wool," which is more correct, for old wool has nothing to do with "art." Now, call waste artificial silk what we will, it is with us to stay, and must be utilized, that is, worked up again. It is mixed with cotton, or perhaps wool. Whatever color such goods are to be dyed, the differently-colored waste artificial silk elements must be stripped. This is done, after the manner of cutting the Indanthrene colors, with caustic soda and hydrosulphite at about 50°C. According to the ease of stripping of the dyestuffs in the artificial silk portions, we use for one liter of bath two to three ounces of caustic soda liquor of 38° B., and 1-1.5 g. of Hydrosulphite conc. powd. Most dyeings are stripped by this procedure, and those which are not or only slightly stripped have to be gotten out. According to the degree of fastness desired, the old material is dyed as already described.



WILLIAM M. STEUART

William M. Steuart, Director of the Census, was first connected with the Census 50 years ago. In 1890 he was appointed Chief of Division of Manufactures, which office he held during the Census of 1900. In 1902, when the Census Bureau was made permanent, Mr. Steuart was appointed Chief Statistician for Manufactures. He was appointed Secretary and Statistician of the U. S. Tariff Commission in 1917. In 1919 he returned to the Census Bureau as Assistant Director; he became Director in 1921. Mr. Steuart is a member of the bar, and formerly practiced law.

Takamine Laboratory, Inc., Clifton, N. J., has announced the election of Eben T. Takamine to succeed his late brother, Jokichi Takamine, Jr., as president of this company.

Fibres Derived from Cellulose

By DR. HERBERT LEVINSTEIN, M.Sc., F.I.C., M.I.Chem.E.

CELLULOSE, the principal constituent of all plant walls, is a typical colloid gel; in this lie all its merits and most of its problems. Its chemical formula $(C_6H_{10}O_5)n$, in which "n" represents not only an unknown and probably variable quantity, but an unknown and probably variable quality or complexity, has long been familiar. After 30 years of constant work we are at last taking a speculative peep at "n," the unknown.

We know that cellulose is built up of glucose units or bricks, as will be shown later. The constitution of glucose has recently and finally been proved by Haworth, in the course of a brilliant series of researches,[1] to consist of a six-atom ring in which five carbon atoms and one oxygen atom are linked together in cyclic form. This gives us the first clear starting out point for deducing the constitution of cellulose. The configuration of the glucose molecule and of the linking of two glucose molecules to form cellobiose was first proved by Haworth and his pupils.[2]

As cellobiose has been shown to be a breakdown product of cellulose, it is probable that cellobiose is either wholly or partly the next block in the construction of the cellulose mass.

By the controlled hydrolysis of cellulose Irvine and Hirst[3] have shown that 95 per cent of pure glucose can be obtained; thus the bricks are glucose and only glucose; of cellobiose Meyer and Mark[4] have recently obtained a 60 per cent yield. It is therefore proved that part, but not necessarily all, the glucose builds up firstly to cellobiose. This far we have reached by purely chemical means.

X-ray examination has given new and important evidence on the variety, size and complexity of the buildings erected out of these glucose bricks, which link up as the next step either wholly or partly to cellobiose. The patterns produced by X-ray diffraction, when measured, proved that in cellulose, whether obtained from ramie, cotton or wood, there is a reproduction of structures which, along the fiber axis, have a length of 10·3 Angstrom units and dimensions at right angles of 8·7 and 7·3 Angstrom units. As two super-imposed glucose residues measure 10·2 A.U. long and approximately 3·6 A.U. thick, it is assumed that the so-called crystal unit of cellulose, the unit which, regularly repeated throughout the cellulose structure, accounts for the diffraction of X-rays, contains four glucose residues.

Other measurements have shown the existence of many longer and wider aggregates of varying length and thickness. These aggregates, to which the name "micelles" has been given, are considered by Mark[5] to be formed by linking together 25 to 30 long chains each composed of 50-100 glucose residues. Thus it would appear that glucose builds up into long chains of varying length and that these are bound together laterally to form linked chains of varying thickness.

The visible fibre is supposed to be made up of bundles of micelles arranged either higgledy-piggledy, or sometimes in a partially ordered manner. Though the proof of the nature of the micelles is not yet complete and the nature of the linkage is necessarily uncertain, the theory has the great advantage that it helps us to comprehend and to explain many of the fundamental problems of the industry.

That the glucose chains are linked through bridge oxygen to carbon atoms in the 1·4 position we know from chemical evidence; that the chains are of varying length and that these chains of varying lengths are linked together to give micelles of varying thickness we know from X-ray diagrams.

We thus arrive at the conclusion that what we call cellulose is not a definitely characterized chemical individual. It is the collective name of a closely related series of compounds which by imperceptible gradations merge one into another. It is, in short, the name of a solid solution of many polymers.

Bleaching or preparing cellulose or dissolving it in liquids may greatly affect this complicated equilibrium of isomers which one can compare to that existing in tannins and gelatine, which are also typical colloids existing in many closely related forms. The industrial consequence meets you at the very outset. Your buyer cannot purchase gelatine and be sure that it will do for photographic purposes until a sample from bulk has been tested in the laboratory and found suitable. Similarly, one cannot purchase bleached cotton linters on a specification and be sure that they will give an acetate of suitable viscosity.

The ripening of alkali cellulose, viscose or acetate doubtless causes alterations in the micelle structure. In all cases this ripening is of great technical value, and is based on purely empirical observation. A closer knowledge of the cellulose structure is therefore of the first importance.

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[1] W. N. Haworth, *J. Soc. Chem. Ind.*, 1929, 48, 240.
[2] W. N. Haworth and co-workers, *J.C.S.*, 1919, 115, 802; 1921, 119, 193.
[3] Irvine and Hirst, *J.C.S.*, 1922, 121, 1213, 1585; 1923, 123, 518.
[4] Meyer and Mark, Ber., 1928, 61, 593.
[5] Mark, *Melliand Textil. B.*, 1929, 11, 695.

It is not unreasonable to expect, as has indeed been shown rather picturesquely on the basis of the micelle theory, that a definite orientation of the units within the cellulose aggregate will give definite physical properties in the final product, the fibers or films.

Once we understand this relationship fully it might well be possible by mechanical or chemical treatment of the fiber during or after precipitation to produce at will an ordered orientation of the micelles so that fibers and films of improved and, perhaps even more important, of more constant and uniform physical properties would result. Variation in tensile strength swelling and dyeing properties would be reduced, and we might arrive at the rayon manufacturer's ideal—a strong, fine, lustrous yarn, always constant; always of even luster; always even dyeing.

If a study of the micelle theory suggests the possibility of obtaining a more constant product it is not the only avenue of approach to this question. The living cell in the plant builds up its cellulose from CO_2 and water through sugars, which later are polymerized to cellulose. Baly[6] and his co-workers have synthesized sugars from CO_2 and water. This synthesis is of great interest, as it reproduces in the laboratory, however inadequately, one of the fundamental reactions of the living plant cell. That this synthesis will be developed in the coming period of chemistry is obvious. There would remain for us to discover the means to aggregate these sugars to enable us to synthesize a cellulose. If this synthesis were a controlled synthesis, the product would have a definite and probably uniform composition, and if not a uniform composition, certainly a different composition from any known cellulose.

J. M. Preston has made careful calculations regarding the quantity and nature of the energy required for this synthesis. It would appear that about 8·8 kw.-hrs. would be required to produce 1 kg. of synthetic cellulose, so that even at ¼d. per unit the power cost would be of the order of 1d. per lb. With a favorable power supply it seems that synthetic cellulose could be produced at a less cost than wood pulp.

These problems may sound a little fantastic, but they are not far outside practical possibilities. They are problems which the chemical engineer will have to solve, and which may have a profound influence in a world of limited acreage and growing appetite, for carbonic acid can be obtained from the air; so that air, water and sunlight are practically the only raw materials.

To return to the micelle theory. As we can magnetize iron by stroking it with a magnet, thereby giving it an ordered polarity, so we can picture the possibility of arranging the micelles of cellulose in an ordered fashion. For example, Lilienfeld increased the concentration of the sulphuric acid in the precipitating bath used for making rayon from viscose and thereby obtained a fiber so greatly improved that a quarter of a million pounds was paid for an exclusive license to work his patents. That was a clever but empirical discovery. Nothing may on the surface seem less likely to lead to practical results than the work on the sugars of the St. Andrew's School under Sir James Irvine.

Then followed descriptions of the invention and subsequent development of the nitrate, acetate, viscose, and cuprammonium methods of rayon yarn production, which descriptions are omitted from the present abstract.

General Observations

Viscose rayon, compared with acetate, its closest and growing competitor, starts out with the cheaper raw material—wood pulp—and very much the cheaper solvent—water, instead of an organic solvent. It is therefore the principal mass-production article. The question of the comparative cost of viscose and acetate and other rayons is, however, complicated. For instance, there is an appreciable difference in the density of viscose rayon and that of acetate yarn, the latter being specifically lighter, and therefore gives more covering power (as fabric) for the same weight of yarn.

In the dry spinning process used in acetate manufacture it is easier to avoid waste, as the fiber is obtained directly from the spinning in a dry state and in its finished physical form. Spinning speeds are also different. The average rate of spinning for 150 denier acetate yarn is 140 metres per minute. The average acetate production is 7 lb. per spindle per day of 24 hours of the denier and at the rate just mentioned.

The rate of spinning of viscose is much lower, being 60 metres per minute for the pot spinning method, of the same denier (150). The output per spindle per 24 hours is only 2 lb.—a notable difference.

The rayon industry works continuously; the cotton industry only 48 hours a week. If the rayon industry had been obliged to work only 48 hours per week, the industry could never have been established. The overhead charges would have made the yarn too dear, just as to-day the Lancashire cotton yarns are unnecessarily dear because of the short hours worked. We in the chemical industry have long realized that a man must work for a third and machinery must work for the whole of the day. Thus we get a proper balance between work and leisure for the human material combined with the best return on the capital. Fortunately the rayon industry has adopted the chemical practice.

We can assume that the all-in cost of a Lancashire spinning mill before the war was about 30s. per spindle. The calculated cost of the 58,000,000 spindles available therefore approaches £90,000,000—an impos-

[6] Baly, *J.C.S.*, 1921, 119, 1025; 1922, 121, 1079; 1923, 123, 185; also *Ind. Eng. Chem.*, 1924, 16, 1016, 1019; *J. Soc. Dyers and Colourists*, 1922, 38, 4.

ing figure. A good proportion of this would appear to have been expenditure which would not have been incurred if the practice had been to keep the spinning machinery running continuously. It is interesting thus to compare the practice of a new with that of an old textile industry—the one based on chemical discovery and the other an ancient craft mechanized in the Victorian era.

With the exception of the acetate, the rayons show little variation in density, but the strength of the fibers varies considerably, as is shown in the following table[7]:

TENSILE PROPERTIES OF RAYON

	Tensile strength air dry in gr./den.	Wet strength in % dry strength.
Natural silk	ca. 3·5	ca. 90
Viscose	1·4	30—45
Lilienfeld	3·5	ca. 70
Bemberg	1·4—1·5	40—55
Nitro	1·4	30—45
Acetate	1·2	60—65

It is seen that the Lilienfeld viscose already referred to far exceeds all others, and equals natural silk for strength. All the rayons are weak when wet—a drawback less pronounced with the acetate, because it takes a lot of wetting. Ironing also has a detrimental action.

Lilienfeld rayon can be guaranteed to stand washing, and will also withstand ironing if ironed both ways, i.e., along the warp and along the weft. This is important, as a growing proportion of the retail textile trade consists of selling guaranteed-fast branded fabrics.

Quite apart from this new development, the quality of viscose put on the market by the leading firms has recently been greatly improved. Filaments are finer and the luster is much more subdued, and not so "tinny" or metallic as was the original viscose. It is to be deplored that large quantities of very inferior viscose have from time to time been placed on the market by foreign makers. Part of the present world depression in the rayon industry is attributed by good judges to this cause.

Lecture delivered before the Institute of Chemical Engineers.

[7] Fierz. Naturforsch. Ges., Zurich, 1930, 132, 52.

EXPORTS OF UNITED STATES EXTRACTS FOR DYEING AND TANNING, BY COUNTRIES

MONTH OF JANUARY, 1930

(Tentative Department of Commerce Figures)

	2311		2319		2321	
	Logwood extract		Other dye extract		Dyeing and tanning materials, crude	
Countries	Pounds	Dollars	Pounds	Dollars	Tons	Dollars
Belgium	5,063	471	....	....	...	....
Denmark	....	....	1,200	170	...	....
France	12,765	1,516	110	15	51	2,295
Germany	1,487	272	....	....	1	100
Sweden	4,090	434	....	....	...	....
United Kingdom	63,761	5,146	8,409	610	...	....
Canada	27,537	3,684	3,160	302	39	2,422
Nicaragua	....	....	100	90	...	....
Mexico	....	....	981	196	20	968
Bermudas	....	....	24	19	...	....
Cuba	....	....	127	75	...	....
Argentine	....	....	110	644	13	1,742
Chile	3,600	500	....	....	1	58
Peru	2,000	170	....	....	2	243
Venezuela	100	17	....	....	...	....
British India	7,840	838	....	....	...	....
Japan	3,300	297	4,309	534	...	....
Philippine Islands	....	....	553	142	...	....
Total	131,543	13,345	19,083	2,797	127	7,828
Shipments to:						
Hawaii	....	....	....	....	1	42

Technical Notes from Foreign Sources

Contributions to Our Knowledge of Silk-Weighting

W. Stockhausen—Seide 34, 320 (1929).—A continuation of the paper mentioned recently in these columns. This second part describes and discusses experiments carried out by the author upon the phosphate process, and is illustrated by a table and two graphs, covering analytical data regarding the P_2O_5 gain and the SnO_2 loss of a given amount of silk, weighted according to described conditions. From the graphs, the author concludes that the process is strictly one of adsorption. "Since the taking up of phosphate is caused by a process of adsorption and is consequently dependent upon the phosphate concentration of the bath, all our attempts to develop a stoichiometric relation between tin and absorbed phosphate led to non-correspondent results. The curve for the loss of tin by the silk (whose separate points could not be so accurately located as those of the phosphate curve, for reasons already mentioned) displays the obvious tendency of a linear function, i. e., the higher the content of phosphate in the bath, and consequently the alkali-content, the more tin goes into solution. The loss of tin proceeds quite independent of the take-up of phosphate."

The paper is continued as Part II on p. 364, this section dealing with the silicate process, and illustrated with four tables and three graphs. The paper closes with the following: "The taking up of phosphate by pinked and washed silk is brought about by adsorption of sodium phosphate upon stannic acid. The alkali set free by hydrolysis from the secondary sodium phosphate used for phosphating dissolves some stannic acid from the fiber, and brings about to a certain extent a slowing-down of the adsorption of phosphate; if one phosphates in baths containing no alkali (potential?), i. e., in a bath of phosphoric acid alone, an intense adsorption of phosphoric acid takes place, whereby the silk is disadvantageously affected in luster and scroop. On the other hand, since through loss of acid the alkali-content of the bath decreases during use, an excess of alkali must be provided before using the bath, by addition of soda. In the wash-waters following phosphating, a splitting off of alkali (hydrolysis) from the adsorbed secondary sodium phosphate takes place.

In the silicate process, a mutual adsorptive process occurs, between silicic acid and a part of the stannic acid fixed upon the fiber. Tin goes into solution in the form of sodium stannate, but after a certain amount of silicic acid has been taken up this solvent-reaction comes to an end, and correspondingly no more silicic acid can be taken up. This "equilibrium" is dependent upon the amount of stannic acid fixed upon the fiber, on the one hand, and on the other, upon the content of the silicate bath in base and acid. Since, then, the weighting-effect of the silicate bath depends upon three components, extensive experience is needed to obtain exactly a prescribed degree of weighting by the silicate method. The fiber takes up silicic acid in perhaps a hydrated form, and also alkali; in the subsequent rinsings the alkali is set free again, completely."

Printing and Discharging

English Patent No. 229,210—I. G. Farben-Ind. A.-G.—A vat dyestuff mixture, in the usual printing-paste containing potassium carbonate, glycerol, and starch-tragacanth-British gum thickener, is mixed with iron-carbonyl in a finely-divided condition, and the goods, after printing, steamed for 5 minutes in the Mather-Platt, the iron oxide removed by a bath of oxalic acid, the goods rinsed, and soaped at the boil.

Dyeing of Aniline Black

Austrian Patent No. 112,608; *Calico Printers' Assn. Ltd. et al.*—The goods, prepared as usual with aniline salt, chlorate, and ferrocyanide, are dried and then heated for a short time at 110°-180° C. dried, and then steamed. The formation of the aniline black proceeds at a considerably greater rate than with other methods, and the loss of aniline is avoided; the blacks do not green, even when not after-treated with chromate, etc.

Disperse-Dyeing

Swiss Patent No. 128,438; *I. G. Farben-Ind. A.-G.*—Color lakes or insoluble pigments are ground up very finely in organic media, and the suspension mixed with water and a dispersing-agent, as a sulphonic acid of aromatic or aliphatic compounds; a 40% solution of dibutyl-sulphanilic acid as sodium salt, for example. Indanthrene Brilliant Violet RK is mentioned in connection with this dispersoid. The dyeing from acid bath yields tones which are of course very fast, upon wool, cotton, silk, artificial silk, etc.

Dyestuffs for Acetate Silk

English Patent No. 229,343; British Celanese Ltd.—The general type of dyestuff proposed is that obtained by coupling diazotized bases of the benzene or naphthalene series to a naphthylene-diamine, or by coupling a diazotized naphthylene-diamine or a mono-acidyl derivative of it to a suitable second component of the benezene or naphthalene series. Examples; diazotized para-nitro-aniline coupled to 1-5-naphthylene-diamine gives an orange-red, and 5-nitro-2-amino-anisol coupled to mono-acetyl-115-naphthylene-diamine give a red dyestuff.

Printing with Vat Dyestuffs

French Patent No. 642,991: *I. G. Farben-Ind. A. G.*—The goods are printed with a paste consisting of a vat dyestuff mixed with a solution of a cellulose ester or ether, then treated with a reducing agent and alkali, and steamed, e. g., the cellulose derivative may be an aqueous solution of methyl cellulose; the discharge "paste" may contain Rongalite C, glycerol, Dissolving Salt B, and potassium carbonate.

Dyeing of Acetate Silk

English Patent No. 305,566: *British Celanese Ltd.*—Derivatives of the nitro-diphenylamines are dispersed by grinding very finely, then heating nearly to 100° C. with neutral Turkey Red oil 50%, till dispersed, then filtering into the dyebath. Reference is made to English Patents No. 219,349 and 224,925. The dyeings are of good fastness to light.

Printing-Method

French Patent No. 653,555: *H. Dreyfus.*—Consists in applying the dyestuffs in solution in volatile organic solvents containing suitable swelling agents. Reserves, discharges, etc., may be employed as usual. After printing, the volatile solvents are evaporated and, if desired, recovered.

Vat Dyestuffs

German Patent No. 438,197 (*addition to No.* 430,632): *I. G. Farben-Ind. A.-G.*—The original patent covered the condensation of the dianhydride of naphthalene-1-4-5-8-tetra-carbonic acid, or its substitution products, with aliphatic or aromatic amines. Some of the products were halogenated, being derived from halogenated dyestuffs, according to this additional patent, are also obtained by halogenating the non-halogenated dyestuffs, the products varying in character according to the method of halogenation. Chlorine or sulphuryl chloride may be used.

Sulphur Dyestuffs

German Patent No. 435,803: *I. G. Farben-Ind. A.-G.*—When copper compounds are added to the melt for sulphur dyestuffs, copper sulphide is of course formed, and this gives the products a dull tone. If the formation of copper sulphide is prevented, the tones are much clearer. The present procedure accomplishes this result by adding a complex copper-cyanogen compound, such as copper-potassium cyanide, to the melt, instead of the simpler copper compounds. The same result can be attained by addition of an alkali cyanide to the sulphur melt which already contains copper sulphide from added copper compounds, to dissolve the copper sulphide to the complex cyanogen derivative.

Sulphur Dyestuffs

German Patent No. 435,612: *I. G. Farben-Ind. A.-G.*—By fusion with sulphur, or with substances which liberate sulphur, of leuco-indophenols in which the hydrogen of the amino-group is substituted by groups which in the sulphur fusion can give rise to the thiazol ring-closing; as, e. g., the methylene or the simple or substituted benzylidene groups. Three examples give products which dye cotton from the sodium sulphide bath in reddish-brown tones, very fast to soap, boiling, and acid, and surprisingly fast to chlorine.

Coerulein-sulphonic Acids

German Patent No. 445,847: *I. G. Farben-Ind. A.-G.*—Coerulein (4 parts) is added to a solution of crystallized boric acid (3 parts) in 60% oleum (30 parts), and the mixture heated at 130°-140° C. for 2 hours. The mixture is poured into ice-water, and the product salted out. The substance forms a black powder, and is easily soluble in water with a blue-black color. It dyes mordanted fabrics green. A similar substance, which gives blue to bluish-black tones on mordanted goods, is obtained from the coerulein prepared from hydroxy-hydroquinone-phthalein.

Anthraquinone Dyestuffs

German Patent No. 445,269: *I. G. Farben-Ind. A.-G.*—Covers the preparation of what seems to be a new class of compounds, gotten by condensation of phenols, naphthols, anisole, etc., with p-diamino-anthrarufine-2-6-disulphonic acid, or with p-di(methylamino-)anthrarufine-2-6-disulphonic acid, in concentrated sulphuric acid, in the presence of crystallized boric acid. The mixture is heated until the intense blue color of the boric acid ester passes over to a brownish- or yellowish-red, and the characteristic absorption-spectrum of the boric acid ester disappears. The mixture at this point, when diluted with water, no longer gives the blue color of the diamino-anthrarufine-disulphonic acid, but a yellow solution with a greenish to brownish cast. Two examples, the products may be used as such as dyestuffs, or may be further worked up, as intermediates, into other dyestuffs.

Vat Dyestuff Products of Benzanthrone Series

German Patent No. 436,888: *I. G. Farben-Ind. A.-G.*—German Patent No. 194,252 cites the preparation of substances, considered to be iso-dibenzanthrones, by treating bz-1-halogen-benzanthrones with caustic alkali or alkali-alcoholates. This procedure covers the condenation of mixtures of bz-1-halogen-benzanthrones with benzanthrones not so substituted (at least, not in that position) by means of a mixture of caustic alkali and alcoholate in an inert solvent or medium. Eleven examples are given.

The Carbic Color & Chemical Co., Inc., announce New Chromazurine HB, a new fast Mordant Blue for printing, recently brought out by Durand & Huguenin. This product is said to be characterized by its brightness of shade, excellent all-round fastness and good working qualities. The product is reported as stable against Hydrosulphite and chiefly recommended for Discharge work, either as a self color or in combination and Bright Green discharges of similar fastness may be obtained by combining this new color with our Modern Yellow.

The General Dyestuff Corporation has sent to the trade separate circulars for printing and for dyeing of the new Fast Violet Salt B which they claim as a stable Diazo Salt of the Fast Violet B Base. Bright violet shades are obtained on various Naphtols and these shades show chiefly excellent fastness to washing and good fastness to light and hot pressing, and pads on Naphtol AS and AS-D are easily white dischargeable, so it is stated.

Lafayette Holt, M.E., of Burlington, North Carolina, inventor of the All-Monel Metal Yarn Beam for handling yarn in the dyehouse and at slashers, has filed a patent for a Package Holder similar to the All-Monel Metal Beam but for treating the yarn in package form. According to the announcement, this invention makes possible a method resulting in level colors and even hues. It is especially suited for knitting mills where hosiery is matched as to shade in pairs.

William C. Dodson, until recently Southern Representative for Smith, Drum & Company, with headquarters at Charlotte, has been transferred to Philadelphia and promoted to Sales Manager for this company. Mr. Dodson, a graduate of the Textile School of North Carolina State College, is the author of a book, "Dyehouse Troubles," and is recognized as an authority on dyeing problems.

Dr. Chas. E. Mullin, Professor of Chemistry, Rayon and Dyeing in the Clemson College (S. C.) Textile School spoke before the Louisiana Section of the American Chemical Society in New Orleans on February 28 upon "Some Recent Advances in the Synthetic Fiber Industry." On March 8 he addressed a joint meeting of the Piedmont Section of the American Chemical Society and the South Carolina Academy of Science in Charleston, S. C., upon "Unusual Textile Materials," and will exhibit a few samples of his world-wide collection of textile fabrics.

Jokichi Takamine, Jr.

Jokichi Takamine, Jr., president of the Takamine Laboratory, Inc., Clifton, N. J., died on February 22, as a result of injuries sustained in an accident in New York City. Mr. Takamine was the son of the late Dr. Jokichi Takamine, the discoverer of Adrenalin and Taka Diastase and founder of the various companies in America and Japan which bear his name.

He succeeded to the presidency of the Takamine Laboratory, Inc., after his father's death in 1922, and was able to build up the business of this company from small proportions to the present prominence which it enjoys as one of the largest manufacturers of enzymic products in the country.

Mr. Takamine had recently returned from a two months' trip to Japan, where he attended the World Engineering Congress as an official delegate of the American Chemical Society. He had been scheduled to speak before the New York Section of the Textile Chemists and Colorists at their Paterson meeting on March 28.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

CHEMIST

Chemist with years of experience in manufacturing and research on sulphonated oil and chemical specialties desires position. Reply to Classified Box No. 590, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

HOSIERY DYER OR ASSISTANT

Young man with 3 years of laboratory and 4 years of dyeing experience in both mill and job dyehouse, desires similar position. Reply to Classified Box No. 593, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED

Head Dyer for Middle Western plant; thoroughly familiar with cotton yarn package system; able to work out shades quickly, correctly and cheaply, and to oversee medium-sized plant. Write fully experience, age, salary, references. Classified Box No. 594, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.